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IN THE
Supreme Court of the United States

OCTOBER TERM, 1984

NICOLET INSTRUMENT CORPORATION,
a Wisconsin corporation,
Petitioner,

v.

BIO-RAD LABORATORIES, INC.
a Delaware corporation,
Respondent.

Petition for a Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

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QUESTIONS PRESENTED

1. Whether in a patent case the trial court and the Court of Appeals for the Federal Circuit may defer to the jury's determination in a general verdict of the ultimate legal issue of validity rather than making an independent determination of the issue based on a review of the underlying evidence.

2. Whether it is error for the trial court to fail to employ special interrogatories setting forth the elements of factual inquiry underlying the determination of the legal issue of obviousness as set forth in this Court's decision in *Graham v. John Deere*.

3. Whether the trial court and the Court of Appeals for the Federal Circuit may rely upon presumed factual findings by the jury to support a jury general verdict of infringement where the claims of the patent in suit are subject to interpretation by the Court as a matter of law.

4. Whether lost profits may be awarded to plaintiff in a patent case where there has been no proof that the plaintiff's instrument is covered by the patent.

RULE 28.1 IDENTIFICATION OF SUBSIDIARIES (EXCEPT WHOLLY OWNED SUBSIDIARES) OF PETITIONER

Nicolet Instrument S.A. de C.V., Mexico.

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NICOLET INSTRUMENT CORPORATION,
a Wisconsin corporation,
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BIO-RAD LABORATORIES, INC.
a Delaware corporation,
Respondent.

PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

Petitioner respectfully prays that a Writ of Certiorari issue to review the judgment and opinion of the United States Court of Appeals for the Federal Circuit (the "CAFC"), entered in this action on July 12, 1984, petition for rehearing *in banc* denied on August 10, 1984.

OPINIONS BELOW

The opinion (A-27)[1] and Erratum (A-52) of the panel of the CAFC below is at 739 F.2d 604, 222. The order of the CAFC denying the petition for rehearing (A-53) is unreported.

The Jury Form of Verdict (Patent) (A-15), the District Court's Final Judgment (A-19), Permanent Injunction (A-21), Order Suspending Injunction Pending Appeal (A-23), and Order Denying Defendant's Motions Under F. R. Civ. P. 50(b) and 59 for Judgment Notwithstanding The Verdict And In Alternative For A New Trial In Its Patent And Antitrust Cases, and Denying Defendant's Motion For The Court To Deny Enforcement Of The Patent In Suit Under The Doctrine of Patent Misuse (A-25) are all unreported.

JURISDICTION

The decision of the CAFC in this case was entered on July 12, 1984. An Order denying Nicolet's petition for rehearing and suggestion for rehearing *in banc* was entered on August 10, 1984. The jurisdiction of this Court is invoked pursuant to 28 U.S.C. § 1254(1) and Rule 17 of this Court's Rules.

CONSTITUTIONAL PROVISIONS AND STATUTES INVOLVED

Art. I, Section 8 of the United States Constitution provides in pertinent part:

> The Congress shall have Power . . . [8] To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the Exclusive Right to their respective Writings and Discoveries.

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[1] The pages of the Appendix are cited as "A-1, A-2 . . .".

35 U.S.C. § 102 provides in pertinent part:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication of this or a foreign country, before the invention thereof by the applicant for patent, or

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or . . .

35 U.S.C. § 103 provides in pertinent part:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences from the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

35 U.S.C. § 112 provides in pertinent part:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

STATEMENT OF THE CASE

Respondent, Bio-Rad Laboratories, Inc. ("Bio-Rad"), is the exclusive license under the only patent in suit, Patent No. 3,319,515 ('515 patent) for an "Interferometric Optical Phase Discrimination Apparatus" (A-1). It filed suit in June of 1981, charging petitioner Nicolet Instrument Corporation ("Nicolet") with infringement by its manufacture and sale of the MX-ECO, an infrared interferometer spectrometer used for measuring the thickness of epitaxial layers on silicon semiconductor wafers.

Jurisdiction was alleged pursuant to 28 U.S.C. § 1338 (a). Nicolet in its answer asserted that the patent was invalid and not infringed. It also filed antitrust counterclaims based on fraudulent procurement of the patent and bad faith enforcement of the patent.

The '515 patent discloses the use of an infrared interferometer for measuring thickness of fast moving thin film such as Mylar as it is being manufactured in a plant environment. The elapsed time occurring between zero order peaks in an interferogram is measured to provide a measurement of thickness directly from the interferogram without the necessity of doing a Fourier transform, a complicated mathematical operation of producing a spectrum from an interferogram. The interferogram is formed by constructive and destructive interference of infrared beams produced by oscillatory mirror movement to vary the path lengths of the beams reflected from the top and bottom surfaces of the moving film to provide only a single reading from each spot on the moving film.

The '515 patent claims a method for determining a physical property of a specimen on the basis of optical phase discrimination in which the steps are to be performed "in sequence" so that infrared radiation is directed first onto the specimen and then into the interferometer ('515 patent, col. 2, ll. 16-43). The device disclosed in the patent, a modification of a commercial interferometer, was supplied only to one customer for measuring moving film thickness but rapidly fell into disuse because of its inadequacies. No disclosure was made in the patent that the claimed method or apparatus could be useful in measuring the thickness of epitaxial layers.

Nicolet's allegedly infringing device, the MX-ECO, and the steps performed by it differ markedly from the device and method disclosed in the '515 patent. The MX-ECO measures the thickness of very thin epitaxial layers formed as an integral part

of silicon semiconductor wafers so that one surface of the epitaxial layer is exposed while the other is buried. Selected wafers are placed sequentially in a drawer in the MX-ECO in a control laboratory and held stationary while a measurement is made.

The sequence of steps used in the MX-ECO differs from those specified in the '515 patent. Infrared radiation is directed into an interferometer which uses a mirror to change the path length of the radiation and thereafter directs it onto the wafer so that reflections occur from the front exposed surface and the buried rear surface of the expitaxial layer. The spectral information obtained is supplied to a computer. A laser fringe counter supplies data points at each half wavelength to the computer. The computer performs first and second fast forward Fourier transforms on the spectral information to provide a spectrum and then a cepstrum which is calculated from the spectrum.

The computer analyzes only the cepstrum, using the data points to give a thickness reading which is typically based upon multiple readings on the same point in the stationary wafer. This differs from the method claimed by the '515 patent in which a single measurement is made at each point because the film is moving rapidly and in which the measurement is made by determining the elapsed time occurring between two zero order peaks in the interferogram.

Bio-Rad's instrument, the FTG-12, upon which the jury's award of damages for lost profits was based, also differs markedly from the device disclosed in the '515 patent. It was developed many years after the modified commercial interferometer disclosed in the patent had been developed and shortly after Bio-Rad had seen an instrument Texas Instruments had built for measuring the thickness of epitaxial layers on semiconductor wafers. In the FTG-12 infrared radiation is directed onto a stationary wafer and then into the interferometer. A thickness measurement is made without the use of any Fourier

transforms directly from the mirror distance traveled between zero order peaks of the interferogram.

Trial commenced on October 5, 1982. The case was submitted to the jury on December 21, 1982, which rendered its verdict on December 23, 1982. The form of the jury's verdict (A-16) was a general verdict holding each claim of the '515 patent valid and infringed. Underlying factual determinations were not revealed. The jury awarded money damages of $3,078,000 based on the proven sales revenue of the MX-ECO of only $3,402,681. It further found that Bio-Rad had not committed any antitrust violations nor misused the patent.

The trial court entered judgment on the jury's verdict on January 18, 1983. The Court made no independent review or determination with regard to the legal issues concerning patent validity or those related to infringement, as is revealed by reference to its brief two page order for judgment (A-19).

Nicolet subsequently filed a motion for Judgment Notwithstanding the Verdict And In The Alternative For A New Trial. On February 8, 1983, the Court filed its order denying these motions. The order contains no substantive discussion of any legal issues involved in the case. (A-25).

Nicolet then appealed to the CAFC. The CAFC rendered its decision on July 12, 1984, affirming the district court judgment, except with respect to the issue of prejudgment interest. In essence, the CAFC took the position that because there was some evidence to uphold the jury's verdict on the issues of validity and infringement, the trial court judgment would be affirmed. It specifically noted that there was no error inherent in submitting questions of law to a jury if the jury is adequately instructed. The CAFC took this position even though the legal issues concerning patent validity and the scope of the claims involved in this case were never decided by the trial court.

REASONS FOR GRANTING THE WRIT

This case illustrates the striking injustice that can befall an alleged infringer when patent issues related to highly sophisticated electronic instruments are tried to a jury, and the court abdicates its duty to decide key legal issues in the case. It also dramatizes the potential for capitalizing on possible confusion of the jury to overcome weaknesses in the position of those asserting claims because of the known propensity of juries to hold patents valid and infringed.[2] *See Dual Manufacturing and Engineering Co. v. Burris Industries, Inc.*, 202 U.S.P.Q. 708, 712 (1979) (Pell, J., dissenting), *en blanc rehearing*, 619 F.2d 660 (7th Cir.) (Pell, J., for the majority), *cert. denied*, 449 U.S. 870, *reh. denied*, 449 U.S. 1027 (1980); *see also* Committee on Patent Litigation, Section of Litigation, American Bar Association, *Patent Jury Trials, A Compendium* (November 10, 1979), Hoppe, *Observations of Trying Patent Cases – Jury*, at E-5 ("As a consequence in real life as we now see it, the jury verdict statistically is heavily overweighted in favor of validity and infringement") and Floyd, *Observations in Trying Patent Cases – Jury* pp. F-3, F-4 ("[T]he available evidence indicates that juries are much more kind to patentees than are judges . . . [A] review of the 28 jury cases reported in the United States Patents Quarterly for the years 1962-1977 reveals that the jury found the patent valid in 25 of them and infringed in 24"); Burton and Levison, *Plaintiff's Use of Juries in Patent and*

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[2] The jurors' lack of technical background made it likely that confusion would result in this case. The case required a knowledge of sophisticated mathematics, chemistry and physics. Of the nine jurors, only two had a college degree. One in bacteriology and one in landscape architecture. Another juror had studied physics, calculus, and chemistry in college. Most of the jurors only had mathematical training through high school algebra. No one on the jury had any background in electronics. All those who had some electronics in their background were removed by Bio-Rad's peremptory challenges.

Trademark Litigation, Intellectual Property Law Review 1978, 435, 441 ("An additional reason for preferring a jury in an infringement suit is the impact upon the jury of the various federally issued documents symbolizing plaintiff's property rights. The letters patent, especially, with its blue ribbon and red seal, is likely to impress the jury.").

This Court has made it clear that issues relating to patentability are to be decided as a matter of law. To give effect to this principle, a careful review must be made of the factual basis of a jury verdict of patent validity, particularly where as here the technology is very complicated and the propensity of a jury to find a patent valid and infringed is greatly increased. It is imperative that this Court exercise its authority to ensure compliance with the constitutional standards for patentability as well as to resolve conflicting positions between the various circuits and within the CAFC itself with regard to legal issues of patentability.[3] It is also important that this Court exercise its authority to provide guidance as to the form that the jury's verdict must take in a patent case. There has been a difference of opinion among the circuit courts on this issue and now have arisen between decisions of different panels of the CAFC.

The conflicts within the CAFC with respect to jury trials are particularly alarming because the CAFC is a new appellate court established on October 1, 1982. It appears to be floundering in its newly found responsibilities in the area of jury trial appeals, an area that is new to the CAFC. It clearly needs the direction of this Court in these formative years. This petition, as well as others now before this Court dealing with similar issues, pre-

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[3] That important issues related to jury trials of patent cases are in a current state of some confusion is evidenced by the petitions of certiorari filed with this Court seeking review of these issues. *See White v. Jeffrey Machinery Co.*, No. 83-1913 (May 22, 1984); *Railroad Dynamics, Inc. v. American Hoist and Derrick Co.*, No. 83-1827 (May 9, 1984); *Computervision Corporation v. The Perkin-Elmer Corporation*, No. 84-173. (July 30, 1984).

sents an opportunity for this Court to provide the necessary guidance to the CAFC on jury trial appeals so it, in turn, can give proper directions to the trial courts on how jury trials in patent cases should be conducted. This Court should also take this opportunity to clarify the important issue of federal law governing the right to an award of lost profits in patent cases where there is no proof that the patentee's product is covered by the patent.

I. THE CAFC'S FAILURE TO REQUIRE JUDICIAL DETERMINATION OF THE LEGAL ISSUE OF PATENT VALIDITY AND ITS FAILURE TO UNDERTAKE AN INDEPENDENT REVIEW OF THE RECORD TO DETERMINE THAT THE STANDARDS OF PATENTABILITY WERE MET ARE INCONSISTENT WITH THE DECISIONS OF THIS COURT AND OTHER DECISIONS OF THE CAFC.

This court has firmly established that patentability is a question of law of constitutional dimensions. *See Sakraida v. Ag Pro, Inc.*, 425 U.S. 273, 279-280 (1976); *Anderson's-Black Rock, Inc. v. Pavement Salvage Co.*, 396 U.S. 57, 61 (1969); *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966); *see also Roberts v. Sears, Roebuck & Co.*, 723 F.2d 1324, 1333-1334 (7th Cir. 1983). Because patents have the effect of granting a private monopoly, the standards of patentability must be applied.[4] *Graham v. John Deere Co., supra* at 6, 19; *Precision Instruments Mfg. v. Automotive Maintenance Co.*, 324 U.S. 806 (1945). Given the constitutional dimension of this inquiry, it has been made clear that no finding of fact can be a substitute for the legal determination of patentability. *Great A & P*

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[4]The CAFC apparently disagrees with this Court's well established characterization of patents as creating a monopoly. It characterizes a patent as merely a "property right" and criticized the district court's use of the term "patent monopoly" in *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1546 (Fed. Cir. 1983)

Tea Co. v. Supermarket Equipment Corp., 340 U.S. 147, 156 (1950) (Douglas J. and Black J. concurring); *Sarkisian v. Winn-Proof Corp.*, 688 F.2d 647, 651 (9th Cir. 1982).

On the issue of anticipation under 35 U.S.C. § 102, a two-step analysis is required: (1) the identity of the patented device, or method, as well as its scope, must be determined by the claims submitted to and allowed by the Patent Office, and (2) the patented device must be compared with the prior art reference. *Roberts v. Sears, Roebuck & Co., supra* at 1333. Construction of patent claims is a question of law. The issue of whether the prior art reference and the patented device and method are substantially identical is pure construction which can be ascertained from the Court's comparison of the description and drawings. *Roberts v. Sears, Roebuck & Co., supra* at 1333; *Super Products Corp. v. D.P. Way Corp.*, 546 F.2d 748, 756 (7th Cir. 1976).

Since anticipation is a matter of law, there were no factual issues for a jury to resolve. Nonetheless, the trial Court acquiesced in having the jury decide this issue and the CAFC likewise deferred to the jury. There has, therefore, never been a proper determination of this legal issue. If a determination had been undertaken, a conclusion that the patent was invalid, based on anticipation, would have been compelled.

A comparison of the work of Lowenstein, the prior art reference in this case, with the claims of the '515 patent demonstrate that every step and element called for in the claims can be found in Lowenstein. The only possible exception is a dependent Claim 6 which specifies that the interferometer is a Michelson interferometer, known for over 100 years. Using such an interferometer in the near infrared rather than a lamellar grating interferometer used by Lowenstein in the far infrared is such a minor substitution that it also would be included within the doctrine of anticipation. *Roberts v. Sears, Roebuck & Co., supra* at 1332. *Shelco, Inc. v. Dow Chemical Co.*, 446 F.2d

613, 614-15 (7th Cir.), *cert. denied*, 409 U.S. 876, 93 S. Ct. 125, 34 L.Ed 2d 129 (1972). Under the circumstances, it is apparent that juror confusion subtituted for a proper legal determination, thereby rendering the strict standard of patentability a nullity.

The question of obviousness under 35 U.S.C. § 103 has certain factual underpinnings, even though it is also ultimately a matter of law. *Sakraida v. Ag Pro, Inc.*, *supra* at 280; *Graham v. John Deere Co.*, *supra* at 17. Because of the constitutional dimension of the inquiry, this Court has required an independent evaluation of the underlying facts to make certain that the legal issue of patentability is properly decided. For example, in *Sakraida v. Ag Pro, Inc.*, *supra* at 280, this Court undertook an independent examination of the evidence before reaching its decision as to obviousness. While the Sakraida decision was informed by the basic factual inquiries noted in *Graham v. John Deere Co.*,[5] *supra*, the issue of obviousness in that case was ultimately decided as a matter of law. *Id.* Similarly, in *Graham v. John Deere Co.*, *supra* at 30-37, this Court undertook a careful review of the available evidence and found the subject matter of the claims of the patent was obvious from prior art.

Although this Court has not had the occasion to clarify the respective roles of the court and finder-of-fact in patent cases tried before juries, a number of circuit courts have determined that this Court's precedents require that the ultimate legal determination of patent validity is to be made as a matter of law by the court and not by the finder of fact. *See, e.g.*, *Automation Electronics Corp. v. Sanders Instruments, Inc.*, 704 F.2d 1133, 1133-34 (9th Cir. 1983); *Baumstimler v. Rankin*, 677 F.2d 1061, 1070 (5th Cir. 1982) (quoting *Graham v. John Deere Co.*, *supra* at 17); *Sarkisian v. Winn-Proof Corp.*, 688

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[5] The three part inquiry set forth in *Graham* is: 1) the scope and content of prior art, 2) the differences between the claims at issue and the prior art, and 3) the level of skill in the pertinent art. 383 U.S. at 17.

F.2d 647, 651 (9th Cir. 1982); *Dual Manufacturing & Engineering, Inc. v. Burris Industries, Inc., supra* at 666-67. A particularly thoughtful discussion of this issue was undertaken by the court in *Roberts v. Sears, Roebuck & Co., supra.* Based upon the patent act and this Court's decisions, the Seventh Circuit set forth the role of the jury and the court in determinations of patent validity. It noted that the tripartite factual inquiry set forth in *Graham* must be undertaken by the jury, but that the court was to draw inferences from those findings to reach the ultimate legal question of validity. *Id.* at 1335. Finding that the trial court had improperly allowed the jury to be the final arbitrator of the legal issue of patent validity, the appellate court reversed. *Id.* at 1343. *Accord, Automation Electronics v. Sanders Instruments, Inc., supra* at 1134.

In the present case, the CAFC took the position that there is no error inherent in submitting questions of law to the jury and obtaining a general verdict on validity, so long as the jury is adequately instructed (A-44). The CAFC's position is clearly in conflict with this Court's rulings, noted above, which require that the legal issue of validity be determined by the Court as a matter of law.

The CAFC's failure to require a proper legal determination of patentability was compounded by the standard of review it used. Because of the absence of any factual findings and the absence of a proper legal conclusion, the CAFC stated that it would presume the existence of factual findings and legal conclusions necessary to support the verdict of the jury (A-30). It then sought to find any record evidence which would support the jury's presumed findings and concluded that the jury's verdict should stand. In finding such record evidence, the court relied primarily upon the testimony of one of respondent's experts on the ultimate issue of obviousness (A-38). It stated that "Nicolet has not shown that reasonable jurors could not agree with [respondent's expert] that one of ordinary skill

in the art would not have derived the claimed invention after reading [the Lowewenstein prior art reference]." In essence, then, the CAFC deferred to the legal conclusions of respondent's expert and the jury's presumed agreement with those conclusions to uphold the jury's verdict on the ultimate legal issue of validity. No independent review of the record was undertaken. This method of review by the CAFC ignored the strict constitutional and statutory standard of patentability and makes any appeal from a general jury verdict of no avail.

The net effect of the CAFC's decision is that to this day there has not been a proper determination as a matter of law of the validity of the claims of the '515 patent. Exercise of this Court's supervision is necessary to ensure adherence to the law clearly expressed by this Court that determinations of patentability are to be made as a matter of law and to ensure that a reviewing court will not simply defer to the legal conclusions of a jury where the trial court has failed to exercise any independent judgment.

In addition to failure to adhere to the law set down by this Court, the CAFC has created confusion within its own decisions as to the role of the court and jury in a patent case. In contrast to the decision in the present case, another panel of the CAFC has specifically held that the reviewing court is to review the issue of obviousness, as "one of law on which it must exercise independent judgment." *Union Carbide Corp. v. American Can Co.*, 724 F.2d 1567, 1573 (Fed. Cir. 1984). It is apparent this Court's direction is needed to clarify the roles of the jury and the court in patent cases. Without clear delineation of these roles, there is a distinct danger that juries involving complex technology will take the easy way out and hold patents valid and infringed because of a failure to comprehend the issues. Juror misunderstanding must not be allowed to substitute for proper legal determinations of patentability required by the United States Constitution and federal law.

II. THE CAFC'S FAILURE TO REQUIRE SUBMISSION TO THE JURY OF THE FACTUAL MATTERS SET FORTH IN *GRAHAM V. JOHN DEERE CO.* BY SPECIAL INTERROGATORIES RESULTED IN FAILURE TO COMPLY WITH THE *GRAHAM* DECISION'S REQUIREMENT THAT FACTUAL INQUIRY BE UNDERTAKEN AND IS IN CONFLICT WITH OTHER OPINIONS OF THE CAFC AND OF OTHER CIRCUIT COURTS.

To assure that the factual underpinnings of a determination regarding the obviousness of invention under 35 U.S.C. § 103 may be meaningfully reviewed, a number of courts have insisted that the trial court employ special interrogatories setting forth the elements of the factual inquiry called for in *Graham v. John Deere Co., supra* at 17. *See, e.g., Roberts v. Sears, Roebuck & Co., supra* at 1341; *Baumstimler v. Rankin*, 677 F.2d 1061, 1071-1072 (5th Cir. 1982). In *Roberts v. Sears, Roebuck & Co., supra* at 1343, the court noted that placement of a general verdict label on a procedure that merely asks the jury to pass upon the ultimate legal question of validity based on general instructions in effect dispenses with the specific factual determinations called for in *Graham*. Thus, the court found that, by their own nature, general verdicts could not ensure that the factual inquiry mandated by *Graham* would be undertaken, and such verdicts could not be allowed to stand. *Id.*

The position of the CAFC on the issue of special interrogatories is, at best, confusing. A panel of the CAFC has recognized the desirability of special interrogatories on the underlying factual matters concerning patent validity and strongly implied that the failure to utilize special interrogatories would be found to be an abuse of discretion. *See American Hoist & Derrick Co. v. Sowa & Sons, Inc.*, 725 F.2d 1350, 1361 (Fed. Cir. 1984), *petition for cert. filed*, No. 83-1829 (May 9, 1984). The *American Hoist* court found special interrogatories were

necessary because, a district court may not solicit only a legal conclusion from the jury. *Id.* Other panels however, have reached different conclusions. For example, in *Railroad Dynamics, Inc. v. A Stucki Co.*, 727 F.2d 1506, 1517 (5th Cir. 1984), *petition for cert. filed*, No. 83-1839 (May 11, 1984), the court stated that failure to submit detailed factual interrogatories would not in every case result in the need for a new trial. In *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1547 (5th Cir. 1983), the court stated that the obviousness question should be submitted to the jury by a special detailed interrogatories, but did not state whether it was error to fail to do so.

It is apparent that without the requirement of special interrogatories detailing the jury's factual determinations, there can be no meaningful review of the issue of obviousness. The lack of any record of the jury's factual findings in the present case presents a situation where the appellate court has assumed that all factual issues were determined favorably to the verdict, thereby making the jury's general verdict virtually unassailable. (See A-30). This makes a nullity of the well established rule that improper fact finding may not substitute for a proper determination of patentability. *See Great A & P Co. v. Supermarket Equipment Co.*, *supra* at 156 (Douglas J. and Black J. concurring); *Sarkisian v. Winn Proof Corp.*, *supra* at 651. Only by requiring use of special interrogatories may the Court ensure that the trial court does not allow the jury to become the final arbitrator of patent validity by abdicating the responsibility to decide the matter as a question of law. The supervision and guidance of this Court is needed respecting this fundamental principle of patent law.

III. THE COURT IMPROPERLY RELIED UPON PRESUMED FACTUAL FINDINGS BY THE JURY WHERE THE CLAIMS OF THE PATENT WERE CLEAR AND SHOULD HAVE BEEN INTERPRETED BY THE COURT AS A MATTER OF LAW.

Both the trial court and the appellate court deferred completely to the jury's presumed interpretation of the scope of the claims of the patent and failed to make a determination of the scope of the claims as a matter of law. The issue, as presented and decided by the CAFC was "whether reasonable jurors, after reviewing all the evidence, could have interpreted the claims [of the patent] to include the sequence of events followed by the MX-ECO." (A-42). This is an erroneous standard because it has long been established that claim construction is a question of law for the judge and not a question of fact for the jury. *Coupe v. Royer* 155 U.S. 565, 574-5, (1895); Deller's *Walker on Patents*, 2nd ed., Vol. 4, § § 230, 231.

In concluding that the jury's interpretation of the claims was proper, the CAFC relied upon the testimony of one of the respondent's expert witnesses on the subject of claim construction. This was done even though the language of the claims was unambiguous.

Claim 1 of the patent required that certain steps be performed "in sequence." The sequence recited in the claim was the only one disclosed and described in the drawings and specification of the '515 patent. Other language in Claim 1 as well as language in Claim 5 included limitations which made it quite clear that the particular sequence called for required that the specimen precede the interferometer. Claim 1 is set forth below and has certain words underlined showing this limiting language.

> 1. A method for determining a physical property of a specimen on the basis of interferometric optical phase discrimination comprising, in sequence, directing analytical radiation upon said specimen along a course such that there is developed an optical phase difference between radiation emanating from a first radiation-reflective surface of said specimen and from a second radiation-reflective surface of said specimen, cyclically varying at a predetermined time rate the

length of the path of travel of said radiation emanating from a given one of the pair consisting of said first radiation-reflective surface of said specimen and said second radiation-reflective surface of said specimen, with respect to the length of the path of travel of the radiation emanating from the other of said pair over a span inclusive of a zero-order peak at which there exists constructive interference between said radiation emanating from said first radiation-reflective surface of said specimen and from said second radiation-reflective surface of said specimen, measuring the elapsed time existing between the scan traverse of said zero-order peak at which there exists said constructive interference and a preselected reference point synchronized in time with the cycle of said scan traverse, said preselected reference point being originally established in location by scanning said specimen through a span inclusive of a central zero-order peak, and determining said physical property of said specimen as a function of said elapsed time.

The above-underlined language, in addition to specifying that the steps be performed in sequence, requires directing the infrared radiation onto the specimen. The claim language then requires that the reflective radiation emanating from the first and second surfaces have their path lengths varied at a predetermined time rate which is performed by the interferometer. This claim language makes it clear that in Claim 1 the infrared radiation must impinge upon the specimen before it impinges upon the interferometer.

The respondent in fact agreed that the sequence of steps in the patent claims was different from that used in Nicolet's MX-ECO (A-42). In the MX-ECO, the interferometer spectrometer precedes the specimens. Nonetheless, the CAFC presumed that the jury interpreted Claim 1 to find that the words "in sequence", and the particular sequence with the specimen preceding the interferometer called for by Claims 1 and 5, could be disregarded.

Claims 1 and 5 of the patent included other express and unambiguous limitation which the CAFC ignored in its presumptions. One critical limitation specified that the physical property of the specimen, i.e., thickness, was to be determined as a function of elapsed time. The limitation was placed in the claims as originally drafted by the patent attorney to distinguish over the prior art Teeple patent which disclosed determining thickness by optical interference phenomena as a function of distance. The MX-ECO does not make thickness measurements by measuring elapsed time or distance. Rather, it measures the thickness of a specimen by analyzing the cepstrum and using data points therein to determine epitaxial layer thickness.

In upholding the jury's general verdict, the CAFC stated that it was reasonable for the jury to conclude "that the MX-ECO's mirror time of travel is functionally equivalent to the mirror distance travelled." (A-43). This conclusion, however, even if assumed to be true, is immaterial to the manner in which thickness is measured in the MX-ECO, and ignores express claim limitations and the plain meaning thereof.

The CAFC in its decision clearly disregarded the principle, long established by this Court, that where the scope of a claim is explicit, the patentee is bound by it. *Keystone Bridge Co. v. Phoenix Iron Co.*, 95 U.S. 274, 278 (1877). This Court, and appellate courts considering the matter, including at least one panel of the CAFC, have recognized that determination of the scope of the claims of a patent is a question of law unless there is some question as to the meaning of a term of art. *See Singer Manufacturing Co. v. Cramer,* 192 U.S. 265 (1904); *McGill, Inc. v. John Zink Co.*, 221 U.S.PQ. 944, 948 (Fed. Cir. 1984); *Super Products Corp. v. D.P. Way Corp., supra.* Indeed, one court has held that allowing the jury to interpret claims taints the entire decisional process. *Roberts v. Sears, Roebuck Co., supra* at 1339.

The CAFC's deference to the jury's presumed claim interpretation also violates another basic tenet of patent law that a claim cannot be interpreted broadly to make out a case of infringement without considering what effect a broad interpretation has on the validity of the claim *see Archal v. United States,* 621 F.2d 421, 428 (Ct. Cl. 1980) *cert. denied,* 448 U.S. 4077 (1981). The purpose of the claims is to precisely define the invention in view of the prior art and to inform the public of the patentee's rights in a specific invention and to "apprise the public what is still left open to them". *Continental Paper Bag Co. v. Eastern Paper Bag Co.*, 210 U.S. 405, 409, 52 L. Ed 1122 (1908) *Motion Picture Patents Co. v. Universal Film Mfg. Co.*, 243 U.S. 502, 61 L. Ed. 871, 876 (1917) Deller's *Walker on Patents,* 2nd ed. Vol. 5, p. 113. The language of the claims and the meaning of that language cannot be ignored or twisted in any direction desired. *See White v. Dunbar,* 119 U.S. 47 (1886).

The CAFC clearly violated this principle as revealed in the following language from its opinion:

> We conclude that reasonable jurors could conclude the claims simply require light to travel from a source to a detector in a manner that develops in an optical phase difference.

Such a broad reading of the claim by the CAFC is incredible in the view of the limitations in the claims which the CAFC has chosen to ignore. The particular sequence specified cannot be reordered in the face of clear and express limitations in the claims. Nor can a measurement based on elapsed time be magically converted into one based on distance or other techniques such as used by the MX-ECO whereby the scope of the claims is broadened to encompass the prior art, including the prior art which included the Teeple reference which measures film thickness as a function of distance.

The CAFC's statement that the jury may interpret the patent claims and that the court need not do so violates the well established law of ths Court and is in conflict with the other decisions of the CAFC. Exercise of this Court's supervision is necessary to ensure that claims are interpreted as a matter of law consistent with the grant of the patent monopoly. Insistence that the trial and appellate courts consider and decide legal issues in their domain is necessary to ensure that improper fact finding will not be a substitute for proper legal determinations.

IV. THE CAFC ERRONEOUSLY UPHELD AN AWARD OF DAMAGES FOR LOST PROFITS DESPITE THE LACK OF PROOF THAT RESPONDENT'S DEVICE WAS COVERED BY THE CLAIMS OF THE PATENT IN SUIT.

There was no proof that Bio-Rad's product, the FTG-12, was covered by the patent in suit. Nonetheless, the jury returned a verdict based on lost profits on lost sales on this instrument, which was upheld both by the trial court and the CAFC. Even though the issue was fully briefed before the CAFC, the questin of whether it was necessary for the respondent's product to be covered by the patent in suit before an award of lost profits may be recovered was not addressed by the CAFC in its opinion.

The question of lost profits in patent suits is one which has not received a great deal of attention in the case law, even though it is of vital importance in the trial of many patent cases. The general test for lost profits in a patent suit was set forth in the leading case of *Panduit Corp. v. Stahlin Bros. Fibre Works, Inc.*, 575 F.2d 1152, 1156 (6th Cir. 1978). The four-part test includes as its first component "demand for the patented product". This clearly implies that coverage of the plaintiff's product by the patent is an essential element of proof of lost profits. This principle was given effect in *Standard Mailing Machines Co. v. Postage Meter Co.*, 31 F.1d 459 (D.C.

Mass. 1929). There the court specifically held that where the plaintiff was in the market in competition with the defendant with a machine which did not embody the patented invention, the plaintiff could not recover damages on the theory of lost sales.

The decision of this Court in *Westinghouse Electric & Mfg. Co. v. Wagner Electric & Mfg. Co.*, 225 U.S. 604, 614-615 (1912), also strongly implies that unless the plaintiff's device is covered by the patent, no award of lost profits is appropriate. In *Westinghouse*, this Court noted that where a plaintiff's patent covers only part of a product and creates only part of the profits, the patentee is only entitled to recover the portion of profits attributable to the patent. *Id.; see also Velo-Bind, Inc. v. Minnesota Mining & Manufacturing Co.*, 647 F.2d 965, 973 (9th Cir. 1981) (damages may not be awarded for loss of sales of unpatented supplies to be used with patented products).

In view of the failure of the CAFC to apply the requirement that in order to recover lost profits a plaintiff must prove that its device is covered by the patent in suit, or even to consider arguments relating to this issue, it is apparent that the exercise of this Court's authority to clarify the matter is necessary. Such a review is all the more made necessary by the jury's outrageous award of lost profits of nearly $40,000 for each instrument which sold for only approximately $60,000.

CONCLUSION

For all the foregoing reasons, a writ of certiorari should be issued to the CAFC. This Court may then exercise its supervisory powers to ensure compliance with the rules of law to be applied in patent cases tried to juries, to resolve conflicts between decisions within the CAFC and between the CAFC and other courts of appeals with regard to fundamental issues arising in such cases, and to clarify important issues of law relating to damage awards in patent cases.

Respectfully submitted

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September 1984

Supreme Court, U.S.
FILED
SEP 20 1984
ALEXANDER L. STEVAS
CLERK

No. 84 — 84-562

IN THE
Supreme Court of the United States

OCTOBER TERM, 1984

NICOLET INSTRUMENT CORPORATION,
a Wisconsin corporation,
Petitioner,

v.

BIO-RAD LABORATORIES, INC.
a Delaware corporation,
Respondent.

Appendix to the Petition for a Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

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September 1984

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EDITOR'S NOTE

PAGES A-1 thru A-14 WERE POOR HARD COPY AT THE TIME OF FILMING. IF AND WHEN A BETTER COPY CAN BE OBTAINED, A NEW FICHE WILL BE ISSUED.

[redacted]

3319515

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

[redacted]

Whereas, THERE HAS BEEN PRESENTED TO THE

Commissioner of Patents

A PETITION PRAYING FOR THE GRANT OF LETTERS PATENT FOR AN ALLEGED NEW AND USEFUL INVENTION THE TITLE AND DESCRIPTION OF WHICH ARE CONTAINED IN THE SPECIFICATION OF WHICH A COPY IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PATENT OFFICE IN THE CLAIMANT (S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID CLAIMANT (S) IS (ARE) ADJUDGED TO BE ENTITLED TO A PATENT UNDER THE LAW.

NOW, THEREFORE, THESE **Letters Patent** ARE TO GRANT UNTO THE SAID CLAIMANT (S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID CLAIMANT (S) FOR THE TERM OF SEVENTEEN YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF ISSUE FEES AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM MAKING, USING OR SELLING THE SAID INVENTION THROUGHOUT THE UNITED STATES.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington this sixteenth day of May, in the year of our Lord one thousand nine hundred and sixty-seven, and of the Independence of the United States of America the one hundred and ninety-first.

Attest:

[redacted]

Witnessing Officer.

Edward J. Brenner

Commissioner of Patents.

FORM PO 277A

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,319,515 May 16, 1967

Philip A. Flournoy

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 30, for "by refrin-" read -- birefrin- --; column 5, line 58, after "30" insert -- movement --; column 10, line 71, the equation should appear as shown below instead of as in the patent:

$$n \cos \theta_1 = \sqrt{n^2 - \sin^2\theta}$$

column 11, line 69, for "through" read -- throughout --; column 12, line 66, for "interence" read -- interference --.

Signed and sealed this 9th day of January 1968.

Attest:

Attesting Officer.

EDWARD J. BRENNER
Commissioner of Patents

May 16, 1967 P. A. FLOURNOY 3,319,515

INTERFEROMETHIC OPTICAL PHASE DISCRIMINATION APPARATUS

Filed Aug. 27, 1963 5 Sheets-Sheet 1

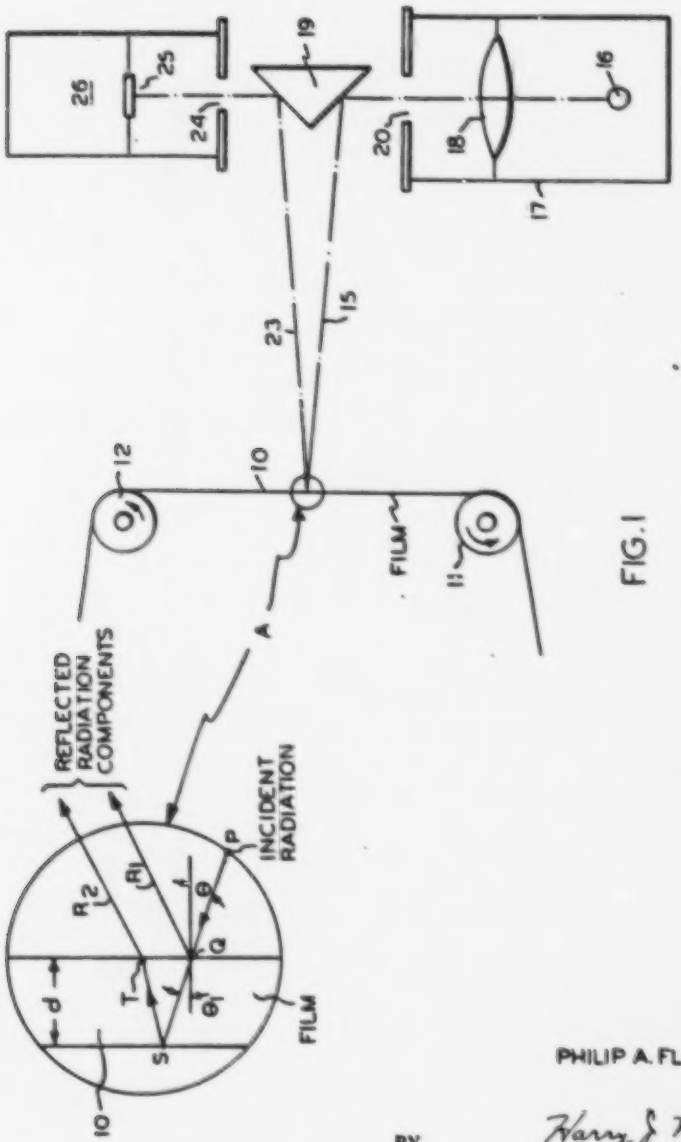

FIG. 1

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May 16, 1967 P. A. FLOURNOY 3,319,515

INTERFEROMETRIC OPTICAL PHASE DISCRIMINATION APPARATUS

Filed Aug. 27, 1963 5 Sheets-Sheet 2

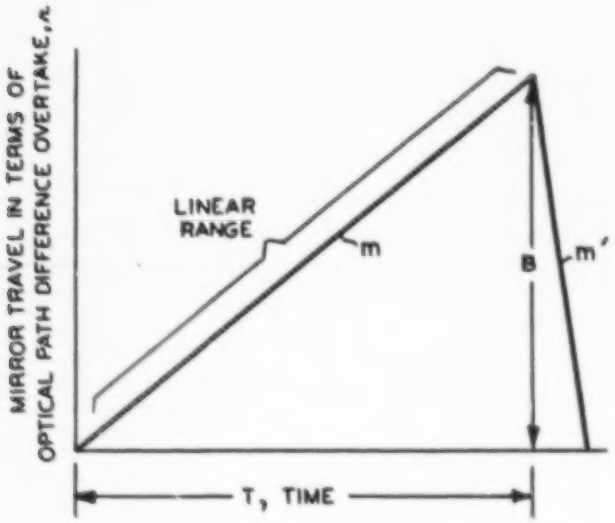

FIG.4

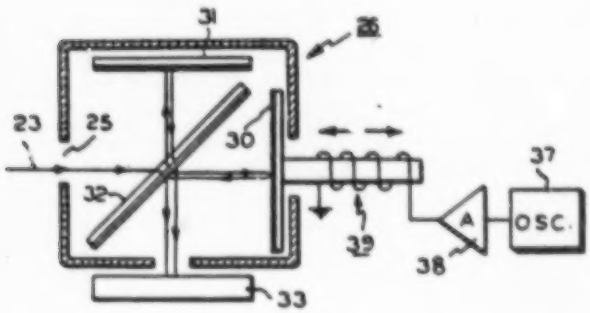

FIG.2

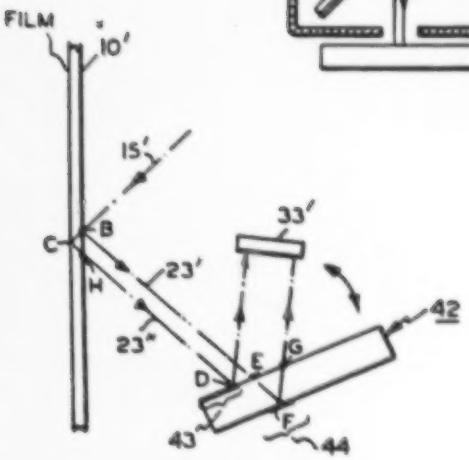

FIG.5

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INTERFEROMETRIC OPTICAL PHASE DISCRIMINATION APPARATUS

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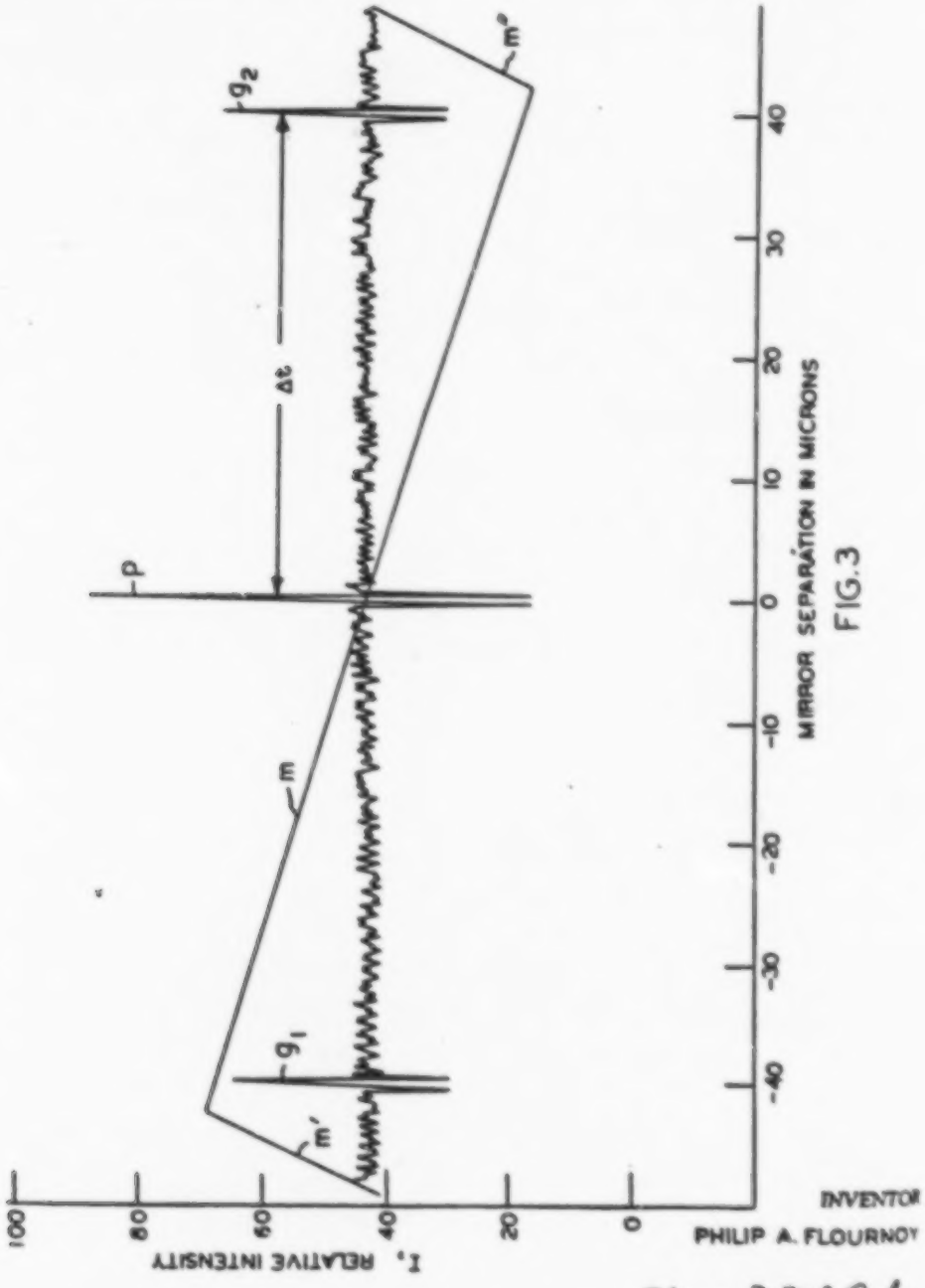

FIG. 3

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INTERFEROMETRIC OPTICAL PHASE DISCRIMINATION APPARATUS

Filed Aug. 27, 1963 5 Sheets-Sheet 4

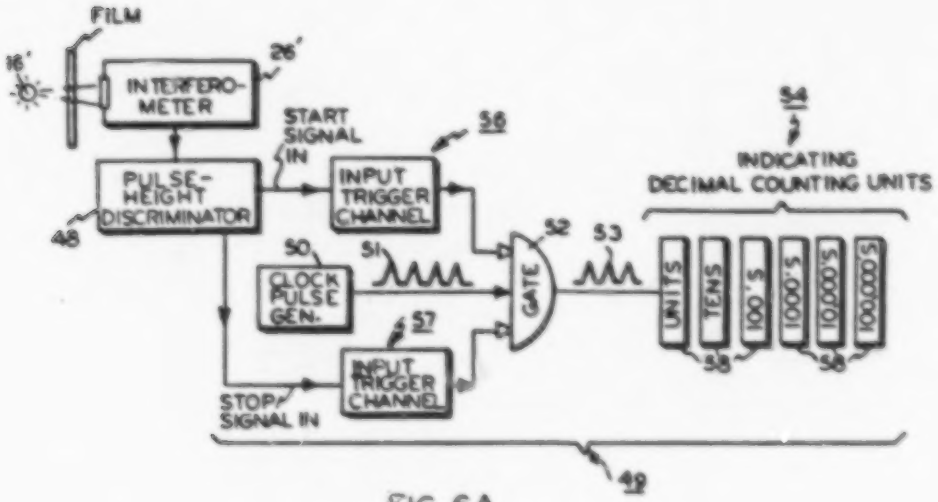

FIG. 6A

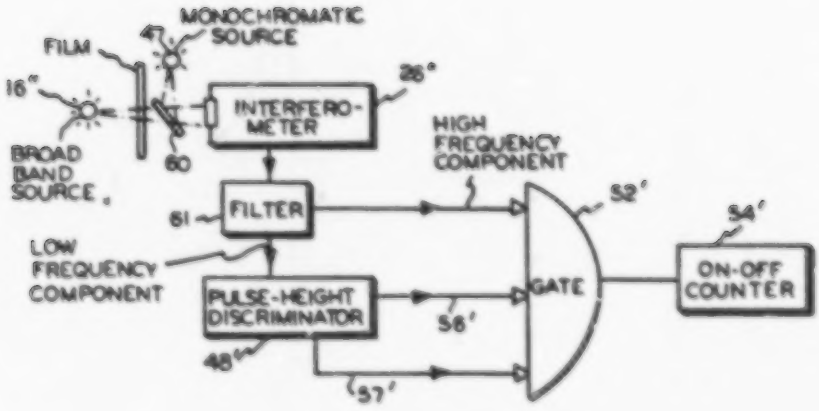

FIG. 6B

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May 16, 1967 P. A. FLOURNOY 3,319,515

INTERFEROMETRIC OPTICAL PHASE DISCRIMINATION APPARATUS

Filed Aug. 27, 1963 5 Sheets-Sheet 5

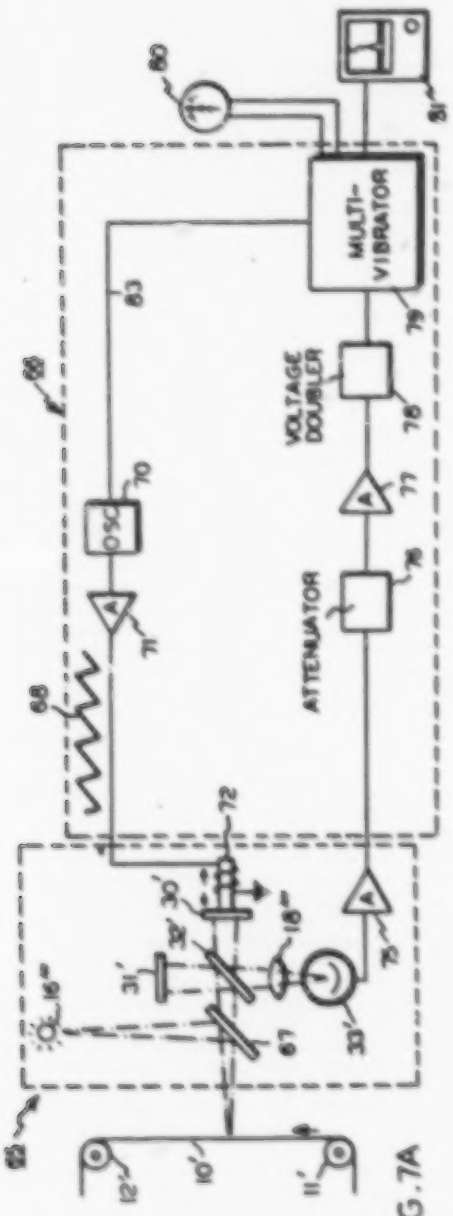

FIG. 7A

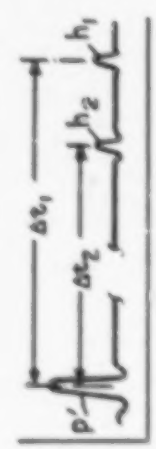

FIG. 9

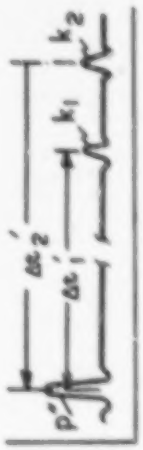

FIG. 10

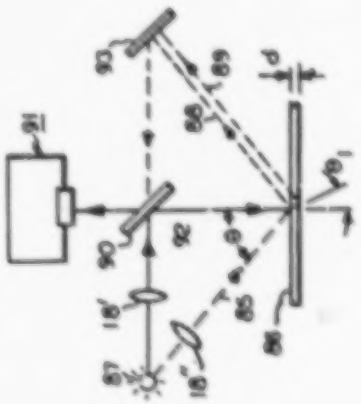

FIG. 8

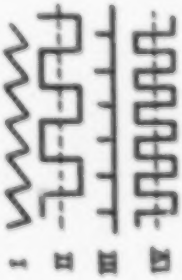

FIG. 7B

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United States Patent Office 3,319,515 Patented May 16, 1967

3,319,515 INTERFEROMETRIC OPTICAL PHASE DISCRIMINATION APPARATUS

Philip A. Flournoy, Wilmington, Del., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware

Filed Aug. 27, 1963, Ser. No. 304,849
7 Claims. (Cl. 88—14)

This invention relates to interferometric examination, and particularly to a method and apparatus for the determination of a physical property of a specimen on the basis of interferometric optical phase discrimination.

A number of physical properties of light-reflective and transmissive substances can be measured by radiation interferometric procedures; however, the methods and apparatus heretofore evolved have been cumbersome in use and require skilled human manipulation for accuracy in the results obtained, so that they have not come into very widespread use. Thus, optical thickness gages of the type disclosed in U.S. Patents 2,518,647, 2,578,859 and 2,655,074 have a restricted application in the leisurely measurement of film thickness by trained personnel conducted on a limited number of samples, such as might be processed in a control laboratory or the like, but that is about the practical limit of their utlity.

There is a clear need for accurate, wide range, rugged, plant-type apparatus for high-speed thickness gaging of running film in the course of its modern manufacture, as there is also for apparatus adapted to measure by refringence, density, refractive index, the uniformity of application of exceedingly thin surface coatings on films such as cellophane and similar materials, or other physical properties, and this invention constitutes an improvement in this art. Other objects include the provision of a highly accurate, compact, relatively simple method and apparatus for interferometric specimen examination which is readily automated and which can be used for a wide variety of material examinations as an aid in the better understanding and control of process operations.

The manner in which these and other objects of this invention are attained will become clear from a study of the detailed film examination description which follows, taken together with the following drawings, in which:

FIG. 1 is a schematic representation of a preferred arrangement of optical equipment utilized in the gaging of a running film, the site of radiation impingement on the film being shown as an enlarged inset view, A, drawn at the bottom of the page,

FIG. 2 is a schematic representation of a reciprocatory reflector type Michelson interferometer which can be used for the development of interference indicia employed in measurement of film gage according to this invention,

FIG. 3 is an interferogram representative of the distinctive interference fringe traces obtained on either side of the central zero-order peak p obtained for the condition of equal-length interferometric arms in the apparatus of FIGS. 1 and 2, the translational time-space course of reciprocatory mirror movement being superposed to indicate its relationship to the radiation interference indicia developed in one type of operational scan of the apparatus,

FIG. 4 is a schematic representation of the time-mirror travel relationship in terms of optical path difference overtake r, for the reciprocatory mirror of the interferometic apparatus of FIG. 2,

FIG. 5 is a schematic representation of a second design of optical apparatus for the practice of this invention,

FIGS. 6A and 6B are schematic representations of two different embodiments of apparatus according to this invention operating in the radiation-transmissive mode and utilizing on-off pulse counters for time interval measurement,

FIG. 7A is a schematic representation of an embodiment of apparatus according to this invention adapted to measure variation from nominal gage of a running film,

FIG. 7B is a schematic representation of the four electrical signal wave forms employed in the apparatus of FIG. 7A,

FIG. 8 is a schematic representation of a preferred embodiment of optical apparatus for the determination of refractive index,

FIG. 9 is a diagrammatic interferogram representative of the interference fringe traces obtained in a single interferometer scan of the apparatus of FIG. 8, and

FIG. 10 is a diagrammatic interferogram representative of the interference fringe traces relied upon for measurement of birefringence according to this invention.

Generally, this invention comprises a method for determining a physical property of a specimen on the basis of interferometric optical phase discrimination comprising, in sequence, viewing the specimen with analytical radiation along a course such that there is developed an optical phase difference between radiation emanating from a first radiation-reflective surface of the specimen and from a second radiation-reflective surface of the specimen, cyclically varying at a predetermined time rate the length of the path of travel of the radiation emanating from a given one of the pair consisting of the first radiation-reflective surface of the specimen and the second radiation-reflective surface of the specimen with respect to the length of the path of travel of the radiation emanating from the other of the pair over a span inclusive of a zero-order peak at which there exists constructive interference between the radiation emanating from the first radiation-reflective surface of the specimen and from the second radiation-reflective surface of the specimen, measuring the elapsed time existing between the scan traverse of the zero-order peak at which there exists said constructive interference and a preselected reference point synchronized in time with the cycle of scan traverse, and determining the physical property of the specimen as a function of the elapsed time, together with apparatus for carrying out the method.

Referring to FIG. 1, a preferred embodiment of this invention employed in film thickness gaging can operate in the open on reflected radiation, making it possible to mount the entire apparatus on a single side of the film in process, although operation in the transmissive mode is entirely feasible, as hereinafter described with respect to FIGS. 6A and 6B particularly. Thus, the film, denoted at **10**, trained over guide rolls **11** and **12**, can be viewed with a small beam of analytical radiation **15** in the course of its running travel over the guide rolls, an upward direction of film travel being arbitrarily shown in this view. Typically, the film speed is about 120 yards/min., and, for a clear cellophane film in the range of 0.1 to 15 mils thickness, for example, the analytical radiation can be a beam of light in the near-infrared region, i.e., in the 1–3 micron range. Interferences in gage measurement occasioned by film whipping are effectively eliminated by viewing the film with the analytical radiation input at near-normal incidence.

The radiation source **16** can typically be a 35 w. tungsten-filament incandescent lamp operating from a 6 v. D.-C. power supply, not shown. Source **16** is mounted within a light-tight housing **17** provided with a double-convex glass focusing lens **18** in line with an aperture **20**, so that a 1:1 image of the hot filament of light source **16**, measuring about ¼" x ⅛" in size, is projected on the film plane via radiation-directing silvered prism **19**.

As shown in enlarged section in inset A, incident radiation **15** impinges on the front radiation-reflective sur-

face of film **10**, from whence a portion is reflected along a course R_1, whereas the bulk of the remainder is transmitted through the film, being characteristically refracted during the transit as shown. This transmitted radiation in due course encounters the back radiation-reflective surface of film **10** and part is returned towards the front surface, again with the characteristic refraction, finally leaving along a course R_2. The exit radiation from the sample, inclusive of that traveling both of the paths R_1 and R_2, is denoted collectively at **23**, which is conveniently returned to the other face of prism **19** and reflected therefrom through aperture **24** into the input port **25** of an interferometer, indicated generally at **26**.

For purposes of description, the specific interferometer used in this embodiment of the invention can be of the Michelson type shown schematically in FIG. 2, except that one radiation-reflective mirror thereof, in this instance arbitrarily chosen as mirror **30**, is reciprocated cyclically through a span hereinafter detailed, whereas the other radiation reflective mirror **31**, is maintained fixed in position. As is conventional, the interferometer embodies an inclined radiation reflecting-transmitting beam splitter **32** (typically, a ¼" thick semireflective glass plate partially mirrored on the underside, disposed at an angle of 45° with respect to mirrors **30** and **31**) which delivers the input radiation in approximately equal-intensity portions to each of the mirrors **30** and **31** from whence the beams are reflected back to beam splitter **32** as indicated by the arrow heads, being then directed outwardly in close adjacency and made to impinge on a photoelectric detector **33**, which in this case can be of the lead sulphide type. The design of interferometer described is the subject matter of copending U.S. Application Ser. No. 120,600, now Patent No. 3,266,582, and comprises a saw-tooth oscillator **37** and associated electronic power amplifier **38**, delivering cyclic saw-tooth voltage pulses to a solenoid-type electrodynamic motor indicated generally at **39**, to thereby reciprocate mirror **30** at a frequency of, typically, 50 cycles/sec.

In operation, the general principles of interferometry are utilized as follows. The phase difference a, which exists as regards any two radiation beams of wavelength λ in reaching a point of observation, such as detector **33**, is a function of the optical path difference b, and can be expressed by the equation

$$a=2\pi b/\lambda \qquad (1)$$

Where the two beams are in phase, there exists "constructive interference," which is evidenced by the development of localized high-intensity radiation regions or "fringes," whereas, where the two beams are out of phase, there is "destructive interference," or regions where the two beams cancel one another to an extent depending precisely on how far out of phase the radiation is.

Referring to inset A, FIG. 1, if the input radiation, PQ, impinges on the film at an angle θ measured from the normal, the first-reflected ray, R_1, upon which my film gage measurement is based leaves the front radiation-reflective surface of the film, whereas the remaining radiation enters the film (of thickness d) on a refracted course along angle θ_1 to point S, located on the rear surface of film **10**. A portion of this radiation is reflected back to point T on the front surface of the film along the refracted course ST, the second reflected ray upon which my measurement is based then emerging as R_2. If the film has a refractive index n, the optical path difference b between R_1 and R_2 can be calculated as

$b=2nd\cos\theta_1$ (refer, p. 262, "Fundamentals of Optics" by Jenkins and White), from which the optical phase difference, using Equation 1, specifically applied, becomes

$$a=\frac{2\pi}{\lambda}(2nd\cos\theta_1) \qquad (2)$$

The intensities of illumination reflected as beams R_1 and R_2 are, respectively, $I_1=\cos^2\theta$ and $I_2=\cos^2\theta_1$, and the intensity I of the two beams considered as a totality is, from pp. 211–213, reference supra,

$$I=4I_1\cos^2 a/2 \qquad (3)$$

Referring to FIG. 2, beam **23**, made up of R_1 and R_2 together, is split into components which are reflected on the one hand to fixed mirror **31**, and rereflected therefrom, and on the other hand to reciprocatory mirror **30**, and rereflected therefrom, giving four separate wave trains within the interferometer.

In accordance with the principles of interferometry, when the path lengths from source to mirrors are equal, there is constructive interference for all wavelengths between the emergent reflected light from the mirrors. The points at which this condition exists are called zero-order peaks, and the central one of these is where the distance of mirror **30** from beam splitter **32** exactly equals the distance of mirror **31** from beam splitter **32** or, stated another way, where the arms of the interferometer are equal. At this central zero-order peak, point Q (Inset A, FIG. 1) on the front surface of the film is effectively the common source for the two split portions of beam R_1, which then constructively interfere one with the other, whereas point S, via point T, is another distinct common source for the two split portions of beam R_2, which then constructively interfere with one another to superadd their effect to the R_1 interference. The result is that the maximum radiation intensity zero-order peak is obtained as this central peak, as evidenced by the spike p shown in the interferogram of FIG. 3. With a Michelson type interferometer, the central peak affords a convenient reference point from which elapsed time measurements can be made as hereinafter described, although it will be understood that any established reference point in time is equally practicable.

Now, if one of the mirrors **30**, **31**, in this case mirror **30**, is moved relative to the other mirror so as to vary the length of light paths of input radiation **23**, it will be seen that, at one point of leftward movement, i.e., at a distance equal to one-half the optical path difference, b, introduced by film **10** out of equality length of the interferometer arms, as viewed in FIG. 2, mirror **30** will shorten the path length of radiation R_2 emanating from the rear-reflective surface of film **10** via points S and T, so that there will be created another zero-order peak g_1, FIG. 3, at which the source path length will be brought into exact equality with the source path length of radiation R_1 emanating from point Q and reflected back to beam splitter **32** from mirror **31**. This sideband peak, compared with central peak p, is of reduced intensity, because it lacks the superadded constructive interference contributed by the remaining two of the total of four radiation wave trains; nevertheless, it is clearly distinguishable above the adjacent noise and incidental uninterpretable complex partial interference signal level, so as to constitute a second point in time upon which to predicate measurement according to this invention.

A second side-band peak of exactly the same amplitude as g_1, namely g_2, is brought into existence on the opposite side of central peak p as a result of the same magnitude of rightward movement of mirror **30** with respect to beam splitter **32**, because the path length of radiation R_1 to mirror **30** is then ultimately lengthened until it is brought into equality with R_2 radiation reflected back from mirror **31**. Therefore, this third zero-order peak affords still another distinctive point in time with respect to either central peak p, side-band peak g_1 or, in fact any other convenient established reference point permitting measurement according to this invention.

Precise control of the translational movement of mirror **30** is, of course, necessary to accurate time measurements and a convenient drive is that provided by saw-tooth oscillator **37** of FIG. 2, which reciprocates the mirror along a time-distance path which is represented by the course line m drawn in as an overlay on the interferogram

ly disposed with respect to zero-order peak p for purposes of this description but it will be understood that there exists a wide choice in this regard. For simplicity in the time measurment of intervals such as Δt drawn between central peak p and side-band peak g_2, it is preferred to maintain the velocity of translation of mirror **30**, i.e., the slope of course line m, constant throughout its scan of the corresponding distance interval, so that the brief mirror return periods, corresponding to terminal traces m' and m'', are deliberately disposed to left and right of sideband peaks g_1 and g_2, respectively.

Quantitatively, the intensity of radiation I_1 seen by photoelectric detector **33** can be expressed as a function of optical path difference overtake r as the product of the intensity distribution from the film and from the interferometer, summed over all of the existing frequencies, by the equation

$$I_1(r)=I_0\Sigma_c \cos^2 \pi cb \cos^2 (\pi cr) \quad (4)$$

where I_0, the source of radiation, is assumed constant and $c=1/\lambda$ is the wave number of the radiation employed. A plot of intensity of photoelectrically perceived radiation in the region of interest is that given by the interferogram of FIG. 3 already elaborated.

Analyzing the travel of mirror **30** throughout one-half of its course only, if the course line m is reproduced somewhat schematically, together with its associated terminal portion m', as shown in FIG. 4, time, plotted as the abscissa, is related to mirror **30** travel in terms of resulting optical path difference overtake r, as ordinate as depicted.

Assuming that one of the zero-order peaks g_1 (or g_2) occurs when mirror **30** is at the inflection ordinate B of its traverse course, the mirror travel between this peak and central zero-order peak p would need to be only $B/2$ since the light reflection path between beam splitter **32** and mirror **30** is a double-length course, extending, as it does, from the splitter to the mirror and back again. Thus, the constant velocity V of mirror **30** throughout the scan from central peak p to a given side-band peak, either g_1 or g_2, is $V=B/2T$, where T is the corresponding constant velocity time interval stepped off along the abscissa, and the rate of optical path difference overtake is then B/T.

The elapsed time interval Δt, between adjacent zero-order peaks is the optical path difference b, in the film divided by the rate of optical path difference overtake, B/T, so that, substituting from Eq. 1,

$$\Delta t=\frac{2n/T \cos \theta_1}{B} \quad (5)$$

or, rearranging terms, d, the film thickness, is a function of elapsed peak-to-peak time, Δt, according to the relationship

$$d=\frac{B(\Delta t)}{2n/T \cos \theta_1} \quad (6)$$

Accordingly, determining the elapsed time, Δt gives a direct measure of film thickness d, subject of course, to the fact that mirror **30** must be at least as great as the maximum optical path in the film, unless the reference point chosen is predeterminedly displaced in a direction narrowing the analytical span, as is usually preferred, since cycle times can then be correspondingly reduced and a larger number of thickness gagings accomplished within a given period of time.

Another design of interferometer, adapted to produce only a single zero-order interference fringe, is that detailed in FIG. 5. Here the film **10'** is viewed by input radiation **15'** impinging on both the front and back radiation-reflective surfaces in the same manner as taught for FIG. 1, with reflection as output radiation indicated schematically as a first-reflected portion **23'** and a second-reflected portion **23''**, which are routed to a plane-surfaced optical plate **42**.

Plate **42** is provided with a first light-reflective coating, such as vaporized aluminum or a similar material, over a limited expanse of the front face **43** interposed across the path of radiation **23''** solely, and with a second light-reflective coating **44** over a small expanse on the rear side of the plate interposed across the path of radiation **23'** solely. Under these circumstances the two wave trains are redirected along courses which bring them into impingement on a radiation detector **33'**, which can be identical in design with detector **33** hereinbefore described.

The scan traverse of plate **42** is obtained by mounting the plate for oscillation around a pivot point D such that the length of path of one beam of reflected radiation, in this instance beam **23''**, is maintained fixed. Whenever the angles of incidence of the radiation on the film and the plate are equal and the optical path differences BCH within film **10'** and EFG for beam **23'** within plate **42** are also equal, as occurs periodically during the cyclic oscillation of plate **42** around pivot D, a zero-order peak is obtained. The necessity for extreme precision in the mirror disposition on plate **42** can be lessened, if desired, by simply half-silvering the entire front mirror face and full-silvering the entire back face.

The reference point constituting the other of the two time interval indicia upon which measurement is based can then conveniently be any chosen point in the oscillatory movement of plate **42** suitably spaced in time from the zero-order peak and signalled as to arrival by the delivery of an electric pulse, which electric pulse output is thus synchronized in time with the cyclic movement of plate **42**.

Typical electrical apparatus for carrying out the method of this invention is shown somewhat diagramatically in FIGS. 6A and 6B, both of which employ conventional pulse-type on-off counters for effecting elapsed time measurement between a zero-order peak and a reference point, but the latter of which dispenses with a clock pulse generator as the time base provider. The first embodiment to be described employs a single, relatively broad-spectrum radiation source **16'** whereas the other embodiment utilizes a broad-spectrum source **16''** in conjunction with a monochromatic source **47**, both operating in the radiation transmissive mode, i.e., with the specimen in examination interposed between the source and the interferometer.

Thus, referring to FIG. 6A, the interferometer indicated generally at **26'** can be identical with that detailed in FIG. 2, including a photosensitive detector (not shown) as integral component. The detector generates a continuous fluctuating voltage signal, such as that shown in FIG. 3, which contains distinctive voltage spikes p and g_1, g_2 characteristic of the central peak and each side-band peak, respectively, as hereinbefore described. To render the response insensitive to the noise and spurious signal readout occupying the interval between successive peaks, resort is had to a conventional pulse-height discriminator **48**, the output of which is limited strictly to pulses of magnitude inclusive of p and g_1, g_2, with all else barred. Under these circumstances, either pair of the pulses p, g_1 or p, g_2 can be employed for measurement of the time interval Δt, FIG. 3, because p is a fixed reference point from which the separation of either sideband peak can be precisely established.

The art of pulse interval measurement is well-advanced, as is described in "Instruments and Control Systems," pp. 125–128, September 1962 issue, published by The Instruments Publishing Company, and requires only an on-off pulse counter, such as that indicated generally at **49**, which embodies a continuously operating clock-pulse generator **50** (typically, a one Mc. oscillator), delivering a constant frequency pulse output **51**, which is thereafter selectively gated by AND gate **52**, so that there is passed to counter **54** a regular pulse train **53** only during the preselected scanning span interval p-to-g_1 or p-to-g_2 upon which time interval measurement is based. Thus, there is AND'ED in gate **52** an Input Trigger Channel **56** actuated exclusively by the counter start signal, which can be either the sensed preception of p or g_1 or

g_2 as desired, although the reference point p is usually preferred because of its fixed location in time. The circuit is completed by an identical Input Trigger Channel 57, reserved to counter stop signal input, which is actuated exclusively by the other zero-order peak of the pair chosen for measurement. Time is then indicated by the registration accumulated in decimal counting units 58 and, if desired, a record printed out, as is standard practice.

The apparatus detailed in FIG. 6B is, in many respects, similar to that of FIG. 6A, except that the time base provider is now a monochromatic source 47, typically a green colored visible light type emitting radiation of about 5000 A. wave length. This radiation is superimposed on the radiation from broad-band source 16" by employment of a transmitting-reflecting mirror 60, so that two distinctive radiation inputs pass to interferometer 26", that received from source 16" providing the zero-order peaks p and g_1, g_2 already described, whereas that from source 47 affords a constant (and relatively high) frequency interference fringe development during the cyclic span traverse of the interferometer. For example, a 5000 A. source 47 was employed in conjunction with a 60 c.p.s. interferometer sweep frequency and a 15 mil sweep span of travel of mirror 30. The central peak-to-side-band-peak spacing for a 10 mil thick film is such that approximately 760 interference fringes are developed from the particular source 47 used, thereby affording a convenient time base. This, of course, occurs simultaneously with the development of the zero-order peaks p, g_1 and g_2 based on radiation from source 16" viewing the film as hereinbefore described.

It is practicable, then, to use a conventional pulse filter 61 as a diverter of the high frequency component of interferometer output to AND gate 52', identical with gate 52 of FIG. 6A, providing a constant frequency time base substitute for clock-pulse generator 50, whereas the zero-order peak pulse signal informative of film gage passes on to pulse-height discriminator 48' and thence to a start signal input trigger channel 56' and a stop signal input channel 57' (neither detailed) identical with the corresponding components of FIG. 6A. Again, the time interval duration is registered in on-off counter 54', exactly as taught for FIG. 6A.

A particularly useful embodiment of this invention, especially suited to on-the-fly gage control by human intervention in a film manufacturing plant, is that shown in FIGS. 7A and 7B. Here it is desirable to continuously indicate visually the variation of film away from nominal processing thickness, so that the operator can take immediate corrective steps or, alternatively, monitor the process in terms of sensed gage variation over a considerable period of time, all as his experience and the specification requirements dictate.

The optical portion of the apparatus is represented schematically within broken-line box 65, whereas the associated electrical assemblage is shown within box 66. The general arrangement is similar to that already described for FIG. 1, with the running film 10', trained about rolls 11' and 12', being viewed in the reflection mode from the right. Again, radiation source 16"' can be a tungsten filament incandescent bulb, operated by D.C. current from a power source not shown, emitting radiation in the wave length range from 1–3 microns. Reflecting-transmitting mirror 67, oriented at an angle of 45° with respect to film 10', is employed to direct source radiation to the film and thereafter receive reflected radiation therefrom, which is then passed to an interferometer of the same type as that shown in FIG. 2, incorporating a fixed mirror 31' and a reciprocatory mirror 30', between which is interposed a reflecting-transmitting mirror type beam splitter 32' which directs the radiation output to photosensitive radiation detector 33', typically a lead sulfide photocell which possesses a maximum gain in the 1–3 micron region.

Mirror 30' is driven in reciprocal saw-tooth mode, 68, as hereinbefore described for the apparatus of FIG. 2, employing a conventional saw-tooth oscillator 70 with associated amplifier 71 as the power source for the conventional electrodynamic motor 72, similar in construction to the voice-coil and magnet structure of a cone-type loudspeaker, which motor has its shaft direct-connected to mirror 30'.

The output voltage signal from radiation detector 33' is passed to preamplifier 75, which can be of the type detailed in FIG. 15.1 and pages 197–198 of "Transistor Circuit Design," published by Texas Instruments, Inc. The amplified voltage output then goes to conventional attenuator 76, which can be of the T-type with 6K ohm characteristic impedance, so as to determine the current drive into the following post amplifier 77 with a constant input voltage. Attenuator 76 can have the circuit shown generally in FIG. 4.13(b), page 123, "Millimicrosecond Pulse Techniques," by Lewis and Wells, publishers McGraw-Hill Book Company, whereas post amplifier 77 is preferably a fixed-gain operational amplifier of the type shown in FIG. 14.1, page 193, "Transistor Circuit Design" supra.

The output next passes into voltage doubler 78, which can have the design shown in FIG. 13–9, described at pages 280–1, "Electron Tube Circuits" by Samuel Seely, publishers McGraw-Hill Book Company, thereby providing a trigger signal of waveform III, FIG. 7B, applicable to bistable multivibrator 79, which can be of the two-transistor D.-C. cross-coupled flip-flop type shown in FIG. 6–5, page 101, "Transistor Circuit Handbook" by L. E. Garner, published by Coyne Company. An indicating meter 80 is connected between the two collectors of multivibrator 79, to give spot indication of film thickness, whereas a gage recorder 81 is connected in parallel from multivibrator 79 to give a continuous record of film gage versus time. Finally, there is provided a wave form alternation connection 83 running from oscillator 70 to multivibrator 79, in circuit with the latter so as to alternate it from one stable state to the other, as depicted by waveform II, FIG. 7B, responsive to flyback of the oscillator output, indicated as waveform I.

The embodiment of FIGS. 7A–7B was devised to detect gage variation from nominal thickness within a preselected tolerance range and, accordingly, it is advantageous to introduce a zero offset, dependent on the nominal film thickness being worked with, in other to limit the relative movement of mirror 30' with respect to mirror 31', to thereby operate with a restricted span of reduced path length, preferably only that region inclusive of the applicable tolerance limits. The investigatory range is thus quite closely confined to the region of allowable film thickness variation only, without incurring the possibility of any extraneous interference foreign to this region and, at the same time, limiting the investigation to the matter of primary concern, and that only, namely, the distance separating the two film faces.

The appropriate offset can be readily obtained by either altering the fixed mirror 31' mounting an exact distance shortening the path from beam splitter 32' to it in order to match the critical distance reached in the path of travel taken by mirror 30' during its reciprocatory travel or, alternatively, the mounting of the latter can be shifted, as by a micrometer screw adjustment, in order to achieve the same objective. Thus, while the primary reference still remains the central zero peak as already described with reference to FIGS. 1–4, there is no need to actually traverse that peak in the cyclic scanning so long as the amount of offset deliberately introduced into the mirror 30', 31' placement is known and taken account of.

In operation, a given side-band peak is preselected as the guide-on, so that the radiation input from beam splitter 32' to photosensitive detector 33' carries with it a characteristic side-band zero-order peak resulting from constructive interference, as hereinbefore described.

Typically, for the monitoring of film thicknesses up to about 12 mils, mirror 30' reciprocates at scan rates from about 10 to 160 cycles per second over travels ranging, respectively, from only 2.5 mils to 0.15 mil, depending upon the tolerance which is to be maintained. The higher the frequency of the scan rate, the greater the number of measurements of film thickness it is possible to make during a given interval of time.

The voltage signal from detector 33' is amplified by preamplifier 75 and then passed to attenuator 76. The attenuator provides a stepped, switch-controlled, manual gain adjustment enabling operator choice of the signal level over the range of film thicknesses measured. Preferably, attenuator 76 permits signal level attenuation in the range of unity down to about 0.01.

The output signal is then post-amplified in amplifier 77, following which it is introduced into voltage doubler 78, which provides the trigger signal depicted as waveform III, FIG. 7B, applied to multivibrator 79. The time relationship of operations is best understood by consideration of FIG. 7B, which shows the several waveforms involved in common time synchronism.

Thus, waveform I is the saw-tooth voltage generated by oscillator 70, this triggering multivibrator 79 via circuit connection 83 so as to switch it, at constant frequency, from one stable state to the other at the instant of flyback, thereby providing the time base waveform II. When a trigger signal in the form of the successive spikes of waveform III is received by multivibrator 79 from voltage doubler 78, the multivibrator output is converted to waveform IV, i.e., reversal of polarity is induced as a result of receipt of a signal corresponding to the encountering of a side-band zero-order peak, so that an averaging of the top and bottom halves of waveform IV by the meter 80 connected between the two collectors of multivibrator 79 provides a reading indicative of film thickness variation from nominal thickness.

From the foregoing, and reference to FIG. 7B, it will be understood that the duration of one half cycle of waveform II constitutes the time base upon which pulse III, the index of film thickness, is superimposed, so that exact centering of perceived pulse III, as shown in FIG. 7B, confirms that actual nominal thickness is being measured. Conversely, movement of pulse III to right or left of the center point, as viewed in FIG. 7A, which center point is determined by calibration from a standard film specimen of known gage, reveals, respectively, that the film is thicker or thinner than the nominal value. Recorder 81, connected in parallel with indicating meter 80, records the running gage variance from nominal and thus enables the operator to verify the effects of any corrective measures he may take responsive to spot readings had on meter 80.

In practice it is often desirable to traverse the film to obtain a thickness profile across the entire width. This is readily accomplished with the apparatus of this invention by mounting the optical apparatus 65, FIG. 7A, within a compact scanning head on the end of a reciprocatory-driven telescopic boom, effecting connection to the electrical components 66 via a flexible cable. In a typical example, polyester film ranging in thickness from 0.1 mil to 12 mils in the various grades produced was the product. Moderate haze in the film affected the transparency, so that the radiation transmission was in the range of approximately 30% to 100%. The running film speed was 50 ft./min., with the usual film width in excess of 3 ft. Operating in the reflection mode with normal light incidence on the film, a vertical film flutter movement of as much as 6–8" in a 12 ft. width could be tolerated without noticeable effect on film thickness measurement.

With a clearance between the optical head and the film of 18", the radiation inspection spot measured about ¼" x ¼". A single traverse of the gage across a 10 ft. width of film required, typically, approximately 3 mins., giving a profile of film thickness extending over a diagonal path of length dependent on film speed. The results obtained were very satisfactory and the apparatus proved to be a valuable aid to manufacturing control.

Referring back to Equation 5 hereinbefore set forth, time interval Δt is seen to be a function of refractive index n as well as length of path d, so that this invention also affords a means for measuring refractive index as well.

A preferred apparatus for the accomplishment of this is portrayed somewhat schematically in FIG. 8. Here the sample 86, of thickness d, can be a running film, a flowing liquid sample or any other physical form of material reflecting radiation from its surfaces as hereinafter described.

The optical arrangement employed is similar to that shown in FIG. 1, except that two interferometric examinations are here made simultaneously, one being normal to the sample, as to which the radiation course is indicated in full-line representation in FIG. 8, whereas the other is at an angle θ to the normal, which radiation course is shown in broken-line representation. This is conveniently accomplished by use of a common source 87 employing focusing lenses 18' and 18", the former of which directs radiation to beam splitter 90, which reflects essentially all of it along course 92 perpendicular to the sample surface, whereas the latter directs radiation at an angle of typically 45° thereto, shown as course line 85. A portion of the normal radiation is reflected back through beam splitter 90 from both the front and rear surfaces of sample 86, and thence to interferometer 91, which can be identical in design with that already taught with respect to FIG. 2. The radiation impinging angularly of sample 86 is reflected from the front surface along a course 88, whereas a portion is refracted internally of the sample along a course making an angle of θ_1 with the normal, to thereafter be reflected from the rear surface and thence leave the sample along course 89. Both of these radiation components are reflected via mirror 93 to beam splitter 90, and thence to interferometer 91.

From the foregoing, it will be understood that there are four separate wave trains available for development of zero-order peaks, the central peak p', FIG. 9, resulting from constructive interference between all four wave trains when the reciprocatory mirror of interferometer 91 arrives at a point in its travel wherein the two interferometer arms are exactly equal. On the other hand, as the reciprocatory mirror moves farther in its reciprocation, side-band zero-order peaks result from constructive interference occurring sequentially as regards radiation impinging normally of the sample along course line 92, i.e., h_1, and as regards radiation impinging angularly of the sample along course line 85, i.e., h_2. Side-band zero-order peaks h_1 and h_2 are spaced apart 1–1.5% of the extreme central peak-to-side-band peak span, but are distinctive enough to permit ready measurement of the time intervals Δt_1 and Δt_2 upon which refractive index measurement can be predicated.

Thus, by Equation 5 hereinbefore set forth, $\Delta t_1 = K(2nd)$ cos θ_1, where $K = T/B$, but, since θ_1 for radiation of normal incidence is zero degrees, cos $\theta_1 = 1$, and, therefore, $\Delta t_1 = K(2nd)$. Similarly, $\Delta t_2 = K(2nd)$ cos θ_1; however, θ_1 in this case is the angle of refraction shown in FIG. 8, which is greater than zero for the angularly incident radiation. Combining the equations, $\Delta t_2 = \Delta t_1$ cos θ_1, or cos $\theta_1 = \Delta t_2/\Delta t_1$, and this ratio of the two applicable time measurements can be easily obtained by conventional voltage analog means.

By Snell's Law, sin $\theta_1 = \sin \theta/n$, where n = refractive index. Using the trigonometric relationship

$$\sin^2\theta_1 + \cos^2\theta_1 = 1$$

and substituting sin θ/n for sin θ_1, the equation

$$n \cos \theta_1 = \sqrt{n^2 - \sin^2\theta}$$

results, whereupon, sin θ being known and cos θ_1 being determined as the time interval $\Delta t_2/\Delta t_1$ ratio, the refractive index can be computed.

Many polymeric materials display the property of birefringence in varying degrees, depending upon the extent of molecular orientation which exists within the crystals. Thus, each crystal will possess three distinctive refractive indices n_x, n_y and n_z, orthogonally related to each other. Birefringence in the length (x)–width (y) plane for thin sheets is then defined as $|n_x-n_y|$. If a film exhibiting birefringence is examined with normally incident radiation in exactly the same manner as hereinbefore taught for film gage measurement, twin side-band peaks k_1 and k_2 are obtained, as shown in FIG. 10. Again, the time intervals Δt_1 and Δt_2 found to exist in scanning from central peak p'' to side-band peaks k_1 and k_2, respectively, can be measured. In operation, as will be clear from the discussion of Equation 5 as applied to normal incidence examinations for the determination of refractive index hereinbefore set forth, optical thickness, defined as the product of a given refractive index n and film thickness d, is related to the time interval Δt by a common constant K', so that, as a generality, $\Delta t=K'nd$.

Then, $\Delta t_2'-\Delta t_1'=K'n_xd-K'n_yd$. If the latter expression is divided by the product of K' times an average thickness $d_{(ave)}$, one obtains birefringence, that is:

$$\left|\frac{K'n_xd-K'n_yd}{K'd_{(ave)}}\right|=\left|n_x-n_y\right| .$$

The average thickness, $d_{(ave)}$, employed here is not particularly critical to the calculation, as long as it is generally within the range of values measured in the gage monitoring already described. Conveniently, the film gage can be measured simultaneously with the birefringence, the same side-band k_1 and k_2 peaks being employed as indicia, and thickness being then taken as the average based upon a time interval immediate $\Delta t_1'$ and $\Delta t_2'$, if extreme accuracy is desired.

Various other properties, such as the presence of particular substances in the product and many other factors, are often accompanied by characteristic radiation interference effects which can be measured and correlated with the causative agency, provided their effects can be isolated, through the use of this invention, and it is, accordingly, intended to be limited only by the scope of the following claims:

I claim:

1. A method for determining a physical property of a specimen on the basis of interferometric optical phase discrimination comprising, in sequence, directing analytical radiation upon said specimen along a course such that there is developed an optical phase difference between radiation emanating from a first radiation-reflective surface of said specimen and from a second radiation-reflective surface of said specimen, cyclically varying at a predetermined time rate the length of the path of travel of said radiation emanating from a given one of the pair consisting of said first radiation-reflective surface of said specimen and said second radiation-reflective surface of said specimen, with respect to the length of the path of travel of the radiation emanating from the other of said pair over a span inclusive of a zero-order peak at which there exists constructive interference between said radiation emanating from said first radiation-reflective surface of said specimen and from said second radiation-reflective surface of said specimen, measuring the elapsed time existing between the scan traverse of said zero-order peak at which there exists said constructive interference and a preselected reference point synchronized in time with the cycle of said scan traverse, said preselected reference point being originally established in location by scanning said specimen through a span inclusive of a central zero-order peak, and determining said physical property of said specimen as a function of said elapsed time.

2. A method of determining a physical property of a specimen on the basis of interferometric optical phase discrimination according to claim 1 wherein said preselected reference point is a second zero-order peak at which there exists constructive interference between said radiation emanating from both said first radiation-reflective surface of said specimen and from said second radiation-reflective surface of said specimen individually.

3. A method of determining the thickness of a radiation-transmissive film on the basis of interferometric optical phase discrimination according to claim 1 wherein said first radiation-reflective surface is one external face of said film and said second radiation-reflective surface is the other external face of said film.

4. A method of determining a physical property of a specimen on the basis of interferometric optical phase discrimination according to claim 1 wherein the length of said path of travel of said radiation emanating from said given one of said pair consisting of said first radiation-reflective surface of said specimen and said second radiation-reflective surface of said specimen is cyclically varied at a substantially constant time rate whereas said path of travel of said radiation emanating from the other of said pair is maintained fixed in length.

5. Apparatus for determining a physical property of a specimen on the basis of interferometric optical phase discrimination comprising, in combination, a source directing radiation upon said specimen of a wavelength adapted to develop an optical phase difference between radiation emanating from a first radiation-reflective surface of said specimen and from a second radiation-reflective surface of said specimen, means cyclically varying at a predetermined time rate the length of the path of travel of said radiation emanating from a given one of the pair consisting of said first radiation-reflective surface of said specimen and said second radiation-reflective surface of said specimen with respect to the length of the path of travel of the radiation emanating from the other of said pair over a span inclusive of a zero-order peak at which there exists constructive interference between said radiation emanating from said first radiation-reflective surface of said specimen and from said second radiation-reflective surface of said specimen, means sensing the occurrence of said zero-order peak, means measuring the elapsed time existing between the scan traverse of said zero-order peak and a preselected reference point synchronized in time with the cycle of said scan traverse, said preselected reference point being originally established in location by scanning said specimen throughout a span inclusive of a central zero-order peak, and means indicating said physical property of said specimen as a function of said elapsed time.

6. Apparatus for measuring a physical property of a specimen on the basis of interferometric optical phase discrimination according to claim 5 wherein said means cyclically varying at a predetermined time rate the length of the path of travel of said radiation emanating from a given one of the pair consisting of said first radiation-reflective surface of said specimen and said second radiation-reflective surface of said specimen with respect to the length of the path of travel of the radiation emanating from the other of said pair consists of a Michelson-type interferometer having one of its mirrors fixed and the other mirror provided with reciprocatory drive means moving said last-mentioned mirror over said span inclusive of a zero-order peak at which there exists constructive interence between said radiation emanating from said first radiation-reflective surface of said specimen and from said second radiation-reflective surface of said specimen.

7. Apparatus for measuring a physical property of a specimen on the basis of interferometric optical phase discrimination according to claim 5 wherein said means measuring said elapsed time existing between said scan traverse of said zero-order peak at which there exists said constructive interference and said preselected ref-

erence point synchronized in time with the cycle of said scan traverse consists of an electrical pulse counter operating responsive to a pulse source generating electrical pulses at a time rate high in comparison with the time required for said scan traverse, provided with switching means starting counting by said counter at the sensing of said preselected reference point and halting said counting at the sensing of said zero-order peak.

References Cited by the Examiner

UNITED STATES PATENTS

2,518,647	8/1950	Teeple et al.	88—14
3,202,052	8/1965	Rambauske et al.	88—14 X
3,238,839	3/1966	Day	88—14

JEWELL H. PEDERSEN, *Primary Examiner.*

JOHN K. CORBIN, *Examiner.*

UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA

BIO-RAD LABORATORIES, INC., a Delaware corporation, *Plaintiff,* v. NICOLET INSTRUMENT CORP. a Wisconsin corporation, *Defendant.*	CIVIL ACTION NO. C81-2553 LHB FORM OF VERDICT (PATENT)
NICOLET INSTRUMENT CORP., a Wisconsin corporation, *Counterclaimant,* v. BIO-RAD LABORATORIES, INC., a Delaware corporation, *Counterdefendant.*	

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UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA

FORM OF VERDICT
(PATENT)

QUESTION NO. 1

Are Claims 1-7 of the Flournoy Patent No. 3,319,515 asserted by Bio-Rad against Nicolet valid or invalid?

(Indicate by checkmarks)

	Invalid	Valid
CLAIM 1	_____	✓
CLAIM 2	_____	✓
CLAIM 3	_____	✓
CLAIM 4	_____	✓
CLAIM 5	_____	✓
CLAIM 6	_____	✓
CLAIM 7	_____	✓

QUESTION NO. 1A

If any of the above claims are invalid, was your decision based upon one or more of the following:

(Indicate by checkmark(s)):

	Yes	No
a. Improper Inventor (Instruction No. 24)	_____	_____
b. Failure to disclose material fact(s) to the Patent Office. (Fraud on the Patent Office) (Instruction No. 46)	_____	_____
c. Lack of novelty (Instruction Nos. 27, 29)	_____	_____
d. Obvious in view of prior art (Instruction Nos. 30-38)	_____	_____

	Yes	No
e. Inoperative disclosure (Instruction Nos. 14, 26)	_____	_____
f. Failure to disclose best mode (Instruction No. 14)	_____	_____
g. Failure to particularly point out and distinctly claim the invention (Instruction No. 16)	_____	_____

If you in your answer to Question No. 1, any of the claims of the Flournoy patent are valid, then answer Question No. 2.

QUESTION NO. 2

Does the Nicolet MX-ECO infringe any valid claims of the Flournoy Patent No. 3,319,515?

(Indicate by checkmarks)

	Not Infringed	Infringed
CLAIM 1	_____	✓
CLAIM 2	_____	✓
CLAIM 3	_____	✓
CLAIM 4	_____	✓
CLAIM 5	_____	✓
CLAIM 6	_____	✓
CLAIM 7	_____	✓

QUESTION NO. 3

If you find that any of the claims of the Flournoy patent are valid and infringed, what total amount of money damages should be assessed against Nicolet for the infringement?

$3,078,000.00

QUESTION NO. 4

Was Nicollet's infringement willful and deliberate?

ANSWER "Yes" or "No"

ANSWER NO

QUESTION NO. 5

If the answer to Question No. 4 is "Yes", state the total award which should be assessed against Nicolet (not to exceed 3 times the amount of damages listed in the answer to Question No. 3 above)

Dated: December 23, 1982

/s/ Gene S. Mori

FOREPERSON

UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA

BIO-RAD LABORATORIES, INC. a Delaware corporation *Plaintiff,* v. NICOLET INSTRUMENT CORP., a Wisconsin corporation, *Defendant.*	CIVIL ACTION NO. C81-2553 LHB

FINAL JUDGMENT

This action came on for trial before the court and a jury, Honorable Lloyd H. Burke, District Judge, presiding, and the issues having been duly tried and the jury having duly rendered its verdict, it is Ordered and Adjudged:

1. That claims 1-7 of U.S. Patent No. 3,319,515 are each valid.

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WILLIAM L. WHITTAKER
CLERK, U.S. DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA

2. That Defendant Nicolet Instrument Corporation ("Nicolet") has infringed claims 1-7 of said U.S. Patent No. 3,319,515 by making, using, and selling "MX-ECO" interferometric epitaxial film thickness gauges.

3. That Plaintiff, Bio-Rad Laboratories, Inc. ("Bio-Rad") shall recover of defendant Nicolet as compensatory damages the sum of Three Million Seventy-Eight Thousand Dollars ($3,078,000.00), with interest thereon as provided by law, said interest to be accrued from January 7, 1983.

4. That Plaintiff Bio-Rad shall further recover its costs of the action.

5. That Defendant Nicolet's counterclaims against plaintiff Bio-Rad are hereby dismissed with prejudice.

SO ORDERED.

Date: 18 Jan. 1983

/s/Lloyd H. Burke

Hon. Lloyd H. Burke
U.S. District Judge

UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA

BIO-RAD LABORATORIES, INC., a Delaware corporation, *Plaintiff,* v. NICOLET INSTRUMENT CORP., a Wisconsin corporation, *Defendant,*	CIVIL ACTION NO. C81-2553 LHB

PERMANENT INJUNCTION

This action came on for trial before the court and a jury, Honorable Lloyd H. Burke, District Judge, presiding, the issues having been duly tried and the jury having duly rendered its verdict, judgment for Plaintiff having been duly entered on January 19, 1983, and the court having heard and duly considered Plaintiff's Motion for a Permanent Injunction and the evidence adduced at trial, it is Ordered, Adjudged and Decreed as follows:

Defendant, Nicolet Instrument Corporation ("Nicolet") its officers, agents, representatives, employees, servants, attorneys, are hereby permanently enjoined and restrained, until expiration of U.S. Patent No. 3,319,515 on May 16, 1984, or until

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CLERK, U. S. DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA

written order of this court, from engaging in activities which infringe, or induce others to infringe, one or more claims of U.S. Patent No. 3,319,515 in any way, such as making, using, or selling the "MX-ECO" interferometric epitaxial film thickness gauges, the structure and operation of which are described and represented in:

(a) Plaintiff's Exhibit A-232, an operational manual;
(b) Plaintiff's Exhibit A-213, a brochure; and
(c) Plaintiff's Exhibit A-267, software listing.

SO ORDERED,

Date: February 4, 1983.

/s/Lloyd H. Burke

Hon. Lloyd H. Burke
U.S. District Judge

UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA

BIO-RAD LABORATORIES, INC., a Delaware corporation, *Plaintiff,* v. NICOLET INSTRUMENT CORP., a Wisconsin corporation, *Defendant,*	CIVIL ACTION NO. C81-2553 LHB

FLEHR, HOHBACH, TEST
ALBRITTON & HERBERT
DOCKETED
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BY
RESPONSE DUE 3-7-83

ORDER SUSPENDING INJUNCTION
PENDING APPEAL

This cause came on to be further heard on motion of Defendant, Nicolet Instrument Corporation ("Nicolet") for a suspension, pending appeal by Nicolet, of the Permanent Injunction heretofore entered against Nicolet and enjoining Nicolet from infringing U.S. Patent No. 3,319,515. After having heard the arguments of counsel and noting that Nicolet appears to be financially sound, the court has determined that it is in the public interest that Nicolet be permitted, pending said appeal, to sell or otherwise dispose of products, including the instrument known as the "MX-ECO", which infringe said patent because said patent will expire May 16, 1984, and the public, having exhibited a marked preference for the MX-ECO over the Plaintiff's FTG-12, should not be deprived of such products sold by Nicolet, including the MX-ECO, during the pendency of said appeal or until said patent expires, whichever occurs first.

THEREFORE, IT IS ORDERED that said Permanent Injunction be and it hereby is suspended pending said appeal: PROVIDED that Nicolet shall execute bond, with sufficient surety,

to be approved by the court, in the amount of $300,000.00 on or before February 14, 1983, conditioned that said bond shall be used for the satisfaction of any and all damages (or such portion thereof/s/LHB) suffered by Plaintiff, Bio-Rad Laboratories, Inc. as a result of the sale or other disposition by Nicolet of instruments, including but not limited to the MX-ECO, which infringe said patent, subsequent to December 23, 1982, the date of the jury verdict.

/s/Lloyd H. Burke

Dated: February 4, 1984

Hon. Lloyd H. Burke
U.S. District Judge

UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA

BIO-RAD LABORATORIES, INC., a Delaware corporation, *Plaintiff,* v. NICOLET INSTRUMENT CORP., a Wisconsin corporation, *Defendant,*	CIVIL ACTION NO. C81-2553 LHB

ORDER DENYING DEFENDANT'S MOTIONS UNDER FED. R. CIV. P. 50(b) AND 59 FOR JUDGMENT NOTWITHSTANDING THE VERDICT AND IN THE ALTERNATIVE FOR A NEW TRIAL IN ITS PATENT AND ANTITRUST CASES, AND DENYING DEFENDANT'S MOTION FOR THE COURT TO DENY ENFORCEMENT OF THE PATENT IN SUIT UNDER THE DOCTRINE OF PATENT MISUSE

The Defendant, Nicolet Instrument Corporation, having filed motions for judgment notwithstanding the verdict and, in the alternative, for a new trial as to both the Plaintiff's action for patent infringement and the Defendant's counterclaim for antitrust, pursuant to Federal Rules of Civil Procedure, Rules

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WILLIAM L. WHITTAKER
CLERK, U. S. DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA

50(b) and 59, and having simultaneously filed a motion to deny enforcement of U.S. Patent No. 3,319,515 on the basis of patent misuse; and this Court having red the Defendant's briefs in support thereof and Plaintiff's briefs in opposition, having heard the arguments of counsel for both parties at a hearing on February 4, 1983, and having given due consideration to the evidence adduced at trial and other pertinent matters of record herein,

IT IS HEREBY ORDERED:

(1) That Defendant's motions for judgment notwithstanding the verdict, as to both the patent and antitrust claims, pursuant to FRCP Rule 50(b), are DENIED;

(2) That Defendant's motions for new trial, as to both the patent and antitrust claims, pursuant to FRCP, Rule 59, are DENIED; and

(3) That Defendant's motion to deny enforcement of the patent by virtue of patent misuse is DENIED.

/s/Lloyd H. Burke

Date: February 8, 1984

Hon. Lloyd H. Burke
United States District Judge
Northern District of California

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

BIO-RAD LABORATORIES, INC., a Delaware Corporation	)	Appeal No. 83-829/83-864.
Plaintiff-Appellee, Cross-Appellant,	)	
v.	)	
NICOLET INSTRUMENT CORP. a Wisconsin Corporation	)	
Defendant-Appellant, Cross-Appellee.	)	

DECIDED: July 12, 1984

Before FRIEDMAN, *Circuit Judge*, NICHOLS, *Senior Circuit Judge*, and BALDWIN, *Circuit Judge*.

BALDWIN, *Circuit Judge*.

This is an appeal from an unpublished decision of the United States District Court for the Northern District of California holding claims 1-7 of U.S. Patent No. 3,319,515 (hereinafter '515 patent or Flournoy patent) for an "Interferometric Optical Phase Discrimination Apparatus" valid and infringed. Judgment was entered on a jury verdict rendered after fourty-four days of trial. We vacate the District Court's denial of prejudgment interest and remand for an award of prejudgment interest or a determination that some reason exists for denying prejudgment interest. In all other respects, the judgment is affirmed.

The Parties

Bio-Rad Laboratories, Inc. (Bio-Rad) is a Delaware corporation with its principal office in Richmond, California. Between

1978 and 1979, Bio-Rad acquired two divisions, Digilab, Inc. (Digilab) and Block Engineering, Inc. (Block Engineering). Digilab was formed as a subsidiary of Block Engineering in 1969 to produce and sell instruments that rapidly measure the crystalline surface layer on semiconductors, known as the epitaxial layer. Since 1970, Digilab has manufactured and sold an epitaxial measuring instrument known as the FTG-12 under an exclusive license from E.I. du Pont de Nemours and Company (du Pont), owner of the '515 patent. When Bio-Rad acquired Block Engineering and Digilab, it also acquired the exclusive license under the '515 patent which included the right to enforce the patent against infringers. The name Bio-Rad will be used throughout this opinion to refer to the conduct of Digilab, and Block Engineering, as well as the conduct of Bio-Rad.

Nicolet Instrument Corporation (Nicolet) is a Wisconsin corporation engaged in the production and sale of electronic instruments. In 1979, Nicolet began selling an epitaxial thickness measuring instrument known as the MX-ECO.

Procedural Background

In 1981, Bio-Rad sued Nicolet for willful infringement of the '515 patent by Nicolet's production and sale of the MX-ECO measuring instrument. Nicolet counterclaimed for a declaratory judgment that the '515 patent is invalid and not infringed, and for alleged violations of the antitrust laws.

Both Bio-Rad and Nicolet demanded a jury trial and agreed to submit the case to the jury on general verdicts without special interrogatories. The jury declared all seven claims of the '515 patent valid and infringed, but not willfully infringed. The jury also concluded that Bio-Rad did not violate sections 1 or 2 of the Sherman Antitrust Act. The jury awarded Bio-Rad $3,078,000 in money damages for the infringement.

Nicolet moved for judgment notwithstanding the verdict (JNOV) and, in the alternative, for a new trial. Nicolet also moved to deny enforcement of the '515 patent for misuse.

The district court denied all three motions and denied Bio-Rad's separate request for prejudgment interest. The trial judge entered judgment on the jury verdicts without comment and permanently enjoined Nicolet from infringing the '515 patent in any way, including the production, use or sale of the MX-ECO epitaxial thickness gauge. Interest was awarded from the date judgment was entered.

Nicolet appeals from the judgment entered by the District Court, and from the court's refusal to declare the '515 patent unenforceable for patent misuse. Bio-Rad cross-appeals from the lower court's denial of prejudgment interest. Although this appeal is from the hudgment entered on the jury verdict, the District Court's denial of Nicolet's motions guides our analysis. Accordingly, we consider the issues raised by the parties in the following order:

I. Grounds For JNOV.

II. Grounds For New Trial.

III. Patent Misuse.

IV. Prejudgment Interest.

Standard of Review

Several cases have issued from this court describing the analysis trial judges should follow when they entertain motions for JNOV or new trial. *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1546, 220 USPQ 193, 197 (Fed. Cir. 1983); *Railroad Dynamics, Inc. v. A. Stucki Co.*, 727 F.2d 1506, 1512-13, 220 USPQ 929, 936 (Fed. Cir. 1984); *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 221 USPQ 669, 672-673 (Fed. Cir. 1984). That analysis need not be repeated here, but description of our appellate review process is useful.

Nicolet has urged that we review the record *de novo*, in part because no interrogatories were submitted to the jury and because the trial judge did not produce a written opinion

discussing reasons for denying Nicolet's motions or describing the facts supporting the jury verdict. Nicolet mistakes our role. The presence of special interrogatories or a written opinion by the trial court certainly makes our task easier but the absence of these aids does not alter our standard of review. In the absence of special interrogatories we presume the existence of factual findings and legal conclusions necessary to support the verdict reached by the jury. The findings and conclusions are controlled by the court's instructions to the jury. *Perkin-Elmer*, 732 F.2d at 893, 221 USPQ at 673. On appeal after denial of a motion for JNOV, appellant must show either 1) that the jury's presumed or express findings are not supported by substantial evidence, or, 2) if the jury's findings were supported by substantial evidence, that the legal conclusions implied from the verdict cannot be supported by those findings. *Perkin-Elmer*, 732 F.2d at 893, 221 USPQ at 673. In sum, appellant must show either that reasonable jurors could not have made the presumed findings or that the conclusions necessary to the general verdict were not supported. The District Court's denial of Nicolet's Motion for a new trial is reviewed on an abuse of discretion standard. *Railroad Dynamics, Inc.* v. *A Stucki Co.*, 727 F.2d at 1512, 220 USPQ at 935. As this description of our approach demonstrates, our role as a reviewing court is circumscribed by standards that place a difficult burden on appellant.

Analysis

I. Grounds For JNOV

To overturn the District Court's denial of the Motion For JNOV, Nicolet presents several grounds for declaring the '515 patent invalid. The various grounds for invalidity will be discussed under the following lettered sections:

A. Anticipation and Obviousness.

B. Fraud.

C. Compliance With The Requirements Of 35 U.S.C. § 112.

D. Infringement.

A. Anticipation and Obviousness

1. Description of the Invention

The '515 patent claims a method and apparatus determining the thickness of a film or a surface layer on a substrate. The apparatus, known as an interferometer, may be used to measure the thin crystalline surface layer of semiconductors, known as the epitaxial layer. The claimed method is represented by claim 1 of the '515 patent, reproduced below:

> 1. A method for determining a physical property of a specimen on the basis of interferometic optical phase discrimination comprising, in sequence, directing analytical radiation upon said specimen along a course such that there is developed an optical phase difference between radiation emanating from a first radiation-reflective surface of said specimen and from a second radiation-reflective surface of said specimen cyclically varying at a predetermined time rate the length of the path of travel of said first radiation emanating from a given one of the pair consisting of said first radiation-reflective surface of said specimen and second radiation-reflective surface of said specimen, with respect to the length of the path of travel of the radiation emanating from the other of said pair over a span inclusive of a zero-order peak at which there exists constructive interference between said radiation emanating from said first radiation-reflective surface of said specimen and from said second radiation-reflective surface of said specimen, measuring the elapsed time existing between the scan traverse of said zero-order peak at which there exists said constructive interference and a preselected reference point synchronized in time with the cycle of said scan traverse, said preselected reference point being originally established in location by scanning said specimen through a span inclusive of a central zero-order peak, and determining said physical property of said speci-

men as a function of said elapsed time.

5. Apparatus for determining a physical property of a specimen on the basis of interferometric optical phase discrimination comprising, in combination, a source directing radiation upon said specimen of a wavelength adapted to develop an optical phase difference between radiation emanating from a first radiation-reflective surface of said specimen and from a second radiation-reflective surface of said specimen, means cyclically varying at a predetermined time rate the length of the path of travel of said radiation emanating from a given one of the pair consisting of said first radiation-reflective surface of said specimen and said second radiation-reflective surface of said specimen with respect to the length of the path of travel of the radiation emanating from the other of said pair over a span inclusive of a zero-order peak at which there exists constructive interference between said radiation emanating from said first radiation-reflective surface of said specimen and from said second radiaition-reflective surface of said specimen, means sensing the occurrence of said zero-order peak, means measuring the elapsed time existing between the scan traverse of said zero-order peak and a preselected reference point synchronized in time with the cycle of said scan traverse, said preselected reference point being originally established in location by scanning said specimen throughout a span inclusive of a central zero-order peak, and means indicating said physical property of said specimen as a function of said elapsed time.

Operation of a preferred embodiment of the claimed invention is illustrated with reference to Figure 1 from the patent in suit. Film or specimen 10 moves over guide rolls 11 and 12 as it is produced. A beam of light emanates from a light source 16 mounted within housing 17. Light 15 travels through convex lens 18 and is projected as a single beam onto the film 10 by a silvered prism 19.

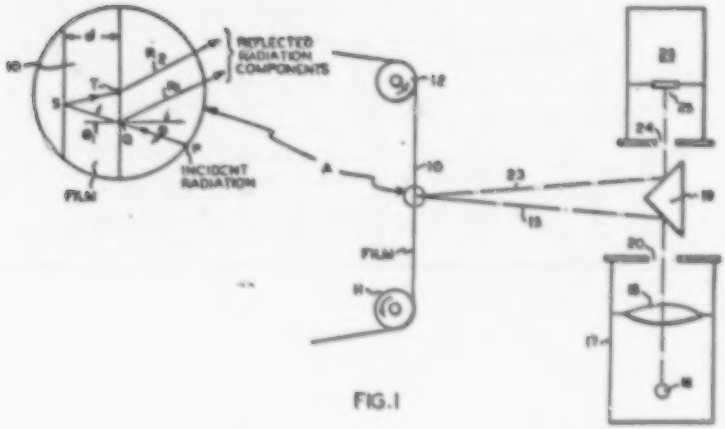

FIG.1

Enlarged inset A shows light 15 impinging upon a front refractive surface of film 10 at Q. A first component of the light is reflected away from the film along R_1, while a second component of the light is transmitted through the film to a back radiation-reflective surface at S. The transmitted component is reflected back along path R_2. Both components of light moving along paths R_1 and R_2 are identified in Figure 1 as 23. The reflected light components traveling along paths R_1 and R_2 are out of phase because of the difference in distance traveled by the first and second components after refraction and reflection. The phase difference results in interference that can be measured by an interferometer.

An interferometer used in appellee's claimed invention known as a Michelson interferometer, is illustrated in Figure 2 of the '515 patent:

As in conventional interferometers, the light 23 strikes an inclined beam-splitter 32 which delivers light to mirrors 30 and 31. The mirrors reflect the light back to beam splitter 32 which

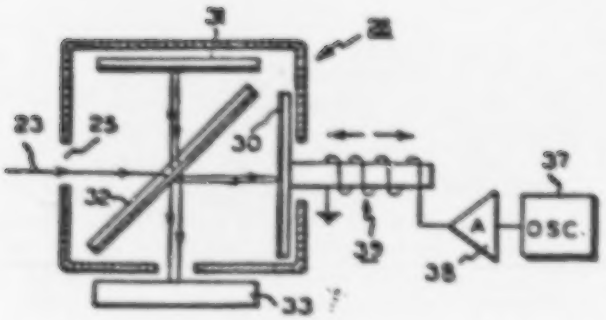

FIG.2

in turn directs the beams towards a photoelectric detector 33. The detector measures the interference between the beams of light. During operation, mirror 30 is reciprocated cyclically over a known distance. The reciprocal motion, or oscillation, is effected by a saw-tooth oscillator 37 and associated electronic power amplifier 38. The mirror 30 oscillates at about 50 cycles/second.

As explained above, the light making up beam 15 is in phase when it reaches the surface of film 10. However, after reflection and refraction, the light traveling along paths R_1 and R_2 are out of phase because of the difference in distance traveled. The differences in distance traveled is related to the thickness of film 10. In the interferometer, a beam splitter divides each of the two components of the light 23 in half, yielding four beams. Two beams are directed to a stationary mirror and the other two to the reciprocating mirror. The mirrors reflect the beam components back to the beam splitter which directs the light to the detector. As the beams emerge from the interferometer together, they interfere with each other. This interference is measured and an interferogram may be produced. The interferogram may look like the interferogram illustrated in Figure

3 of the '515 patent, reproduced below:

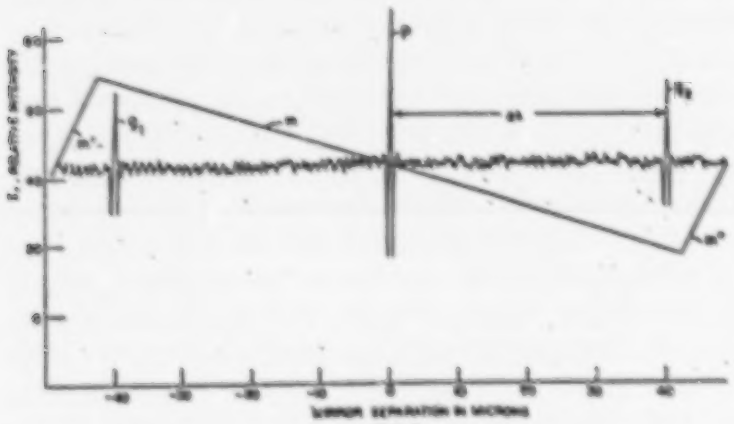

FIG.3

Central peak P is generated when all four beam components interfere constructively. This occurs when the mirrors 30 and 31 are the same distance from the beam splitter 32. Side peaks g_1 and g_2 occur when the difference in the distances between the beam splitter and the two mirrors corresponds to the optical retardation caused by the film. The side peaks are of lesser intensity than the central peak because only two of the beam components are constructively interfering.

The invention claimed in the '515 patent uses the distance between peaks to determine the thickness of the film. Figure 3 shows the "nirror separation in microns." This is the distance the mirror has traveled from the position where the four beams interfere constructively, known as the zero position. The time between the occurrence of two reference peaks may be measured directly from the interferogram to determine the thickness of the film.

2. **Anticipation**

Nicolet argues that the claims, except claim 6, read on a

publication by Lowenstein and are therefore invalid under 35 U.S.C. § 102. Lowenstein used infrared radiation and a lamellar grating interferometer which does not use mirrors that oscillate like those of a Michelson interferometer. Lamellar grating interferometers were used when light in the far infrared was employed because, at the time, there were no efficient beam splitters for light in the far infrared. One measurement or run of the interferometer used by Lowenstein could take six to eight hours. Nicolet's argument is that the substitution of a Michelson interferometer would have been obvious to one of ordinary skill in the art when not working with far infrared radiation. There was also evidence that the Lowenstein article differs from the claimed invention because Lowenstein does not teach the measurement of thin films from peaks of an interferogram. Because of these substantial differences between the claimed invention and the Lowenstein reference, the appropriate analysis is under 35 U.S.C. § 103.

3. **Obviousness**

The parties agreed that a person of ordinary skill in the art would be an instrument designer with a college degree in physics or engineering and some practical experience in the design of optical instruments. Each party proffered expert testimony on the factual question of the scope and content of the prior art. It is notable that Bio-Rad's expert, Gebbie, was the only expert capable of testifying on the basis of first-hand experience with the level of skill in the relevant time period. One of Nicolet's experts, Lowenstein, whose article was relied on to assert invalidity, said:

> As far as the designers of commercial or industrial interferometers were concerned, I think I don't know anybody or, at least not well enough to be able to form an opinion about his level of skill.

This excerpt from the testimony is produced to illustrate the importance of the jury's role in ascertaining the content of the

prior art. The jurors must discern how a person of ordinary skill in the art would have interpreted available art at the time the invention was made. The factfinder's interpretation of prior art references is necessarily guided by the credibility given the testimony of the experts. Here, the jury presumably credited the testimony of Gebbie rather than the testimony of Lowenstein in deciding what the Lowenstein article would have meant to one of ordinary skill in the art. Given the different familiarity of the experts with those skilled in the art at the relevant time, that evaluation by the jury was reasonable and cannot be successfully challenged on appeal. The only question for this court, therefore, is whether, on the facts testified to by Gebbie and presented by Bio-Rad, reasonable jurors could conclude that the invention would have been obvious to one of ordinary skill in the art at the time it was made.

Nicolet argues the claimed invention would have been obvious in view of the Lowenstein publication. The Lowenstein publication used a lamellar grating interferometer to measure refractive properties of sapphire. The interferometer used by Lowenstein had a set of stationery plates and a set of moveable plates. To analyze the sample being studied, the moveable plates were run in one direction by a motor until the motor was shut off. One run, or scan, typically took 6 to 8 hours. After one scan was completed a motor drove the interferometer back to begin a new scan. The claimed invention requires cyclical mirror movement. Lowenstein did not disclose or suggest the mirror oscillation required by the claimed invention.

Dr. Gebbie testificd that those of *ordinary* skill in the art were skeptical of Michelson rapid scan interferometers, which provide cyclical mirror movement, and would not have interpreted the Lowenstein article to suggest using a Michelson interferometer as required by the claimed invention. It appears from Gebbie's testimony that a person of ordinary skill in the relevant art would not have arrived at the claimed invention

after reading the Lowenstein article. Nicolet has not shown that reasonable jurors could not agree with Gebbie that one of ordinary skill in the art would not have derived the claimed invention after reading the Lowenstein publication.

Further, there was evidence that the claimed invention enjoyed commercial success in the measurement of electrically conductive film and epitaxial layers of semiconductors. The claimed invention permitted simple accurate measurement of substrates moving at high speeds. It reduced labor costs and increased productivity. The savings were in some instances so great that one witness said the $65,000 instrument had paid for itself in about two weeks. The jury had to consider this success in reaching its presumed conclusion that the claimed invention would not have been obvious.

We have no doubt that conflicting evidence was presented at trial by Nicolet on the appropriate interpretation of the Lowenstein publication and commercial success. That, however, does not carry Nicolet's burden on appeal.

B. Fraud

Nicolet argues the '515 patent is invalid because Flournoy, the named inventor, did not actually invent the claimed subject matter. Nicolet contends that Myron Block, not Flournoy, was the inventor. According to Nicolet, Myron Block permitted Flournoy, a DuPont engineer, to claim inventorship to induce DuPont to invest in Block Associates (a predecessor of Block Engineering founded by Myron Block). There is conflicting testimony in the record with regard to how the invention was developed. Nicolet's case on fraud principally hinges on the credibility of Myron Block. However, the development of the claimed invention described by Bio-Rad during the trial adequately supports the finding that Flourney invented the claimed subject matter.

Dr. Philip Flournoy joined DuPont in 1960 as a research

engineer in the Engineering Physics Laboratory at the DuPont Experimental Station. A group of scientists at DuPont, including Dr. Flournoy, were engaged in developing instruments for monitoring and controlling a wide variety of industrial manufacturing processes. Dr. Flournoy wanted to develop an instrument that could provide rapid information on the thickness of expitaxial layers on semiconductors of electrically conductive film, known as Mylar, during the production process. Previous techniques were undesirably slow because the spectrometers used required a relatively long period of time to produce one spectrum. Flournoy hoped that a rapid scan interferometer could provide desired spectral information rapidly in a short period of time.

In the course of investigations on measuring Mylar film and epitaxial layers, Dr. Flournoy observed the presence of small peaks ("side bursts") on either side of the main peak of an interferogram. To determine whether these small peaks were associated with the equipment or with the sample, Dr. Flournoy took interferograms of samples having different thicknesses and observed that the spacing between these peaks varied directly with the thickness of the sample. This determination led him to conclude that, with an adequate interferometer, he could construct an instrument for measuring film thickness, utilizing a rapid scan interferometer.

In March, 1961, Flournoy and his supervisor visited Block Associates to evaluate Block Associates as a vendor of rapid scan interferometers for DuPont's process control equipment needs. That trip satisfied Flournoy that Block Associates could produce sufficiently high quality equipment to satisfy DuPont's requirements.

By December 1961, Flournoy had obtained a suitable interferometer. With that instrument, he performed a series of experiments whereby he took interferograms from samples of

Mylar, detected distinguishable side bursts in the interferogram, and utilized the distance between those side bursts to calculate the thickness of the Mylar samples. The accuracy of these experimentally obtained thickness readings was verified by comparing them to the actual thickness of the film, measured with a micrometer. By July 1962, Flournoy further refined the specifications for the various operational parameters for a thickness measuring instrument.

In July 1962, there were discussions between DuPont and Block Associates concerning the possibility of Block's manufacturing the thickness measuring instrument for DuPont. In the course of these discussions, the parties recognized that Block Associates and DuPont had possibly conflicting claims to inventorship of the process and apparatus embodied in the thickness gauge. It was agreed that the parties would collect and exchange documentation of their inventions. On the basis of the exchanged documentation, the patent attorneys would determine which party was entitled to any of the invention(s) that might reside in the thickness gauge under development.

After the documents were exchanged, Block Associate's patent attorney and DuPont's patent attorney determined that Flournoy was the inventor. Specifically, they found that Flournoy could prove he had conceived the invention of measuring film thickness with reference to the side burst on the interferogram at least as early as March 23, 1961 and that he could prove a reduction to practice of that invention in December 1961. Block, on the other hand, could not prove that he or his employees had conceived the invention any earlier than May 4, 1961, nor could Block prove a reduction to practice of the invention any earlier than June 29, 1962. A memorandum was produced, and signed by both attorneys, wherein Myron Block recognized Flournoy as the inventor of the subject matter ultimately claimed in the '515 patent.

These facts adequately support the jury's presumed finding that Dr. Flournoy invented the claimed subject matter. Whether a different conclusion could have been reached on the basis of conflicting testimony presented by Nicolet at trial is not the issue before this court.

C. Compliance With The Requirements of 35 U.S.C. § 112

Nicolet argues that the '515 patent is invalid for failure to disclose the best mode and because the disclosed invention is inoperative. Both arguments are premised on the omission of Automatic Gain Control circuitry (AGC) from the specification. On appeal, Bio-Rad identifies specific testimony establishing that the disclosed invention is fully operative and that at the time the patent application was filed, the AGC was not considered a necessary part of the invention or of the best mode for practicing the claimed invention. Nicolet's arguments on these issues amount to little more than bald assertions by counsel. As appellant, Nicolet has not satisfied this court that reasonable jurors could not find that the best mode requirement was satisfied or that the claimed invention was operative.

Nicolet also asserts that the claims are vague and indefinite. Here again the argument amounts to little more than a statement by counsel supported by some evidence in the record that the language "scanning the specimen" does not have a definite, understandable meaning. Bio-Rad presented testimony showing that a person of ordinary skill in the art would understand the phrase "scanning said specimen" to mean that a movable mirror of the interferometer must reciprocate when the phrase is read in light of the specification. Nicolet has not presented a basis for overturning the jury's presumed resolution of this issue in Bio-Rad's favor.

D. Infringement

Nicolet contends its MX-ECO machines do not infringe any claims of the '515 patent for two reasons. According to Nicolet,

the method claims require light to be directed from a source onto a sample, then reflected from the sample to an interferometer and then onto a detector. Both parties agree that the MX-ECO does not follow this sequence. During operation of the MX-ECO, light moves from a source into an interferometer, then onto the sample, and from the sample to a detector. The issue here is whether reasonable jurors, after reviewing all the evidence, could have interpreted the claims to include the sequence of events followed by the MX-ECO. *Envirotech Corp.* v. *Al George, Inc.*, 730 F.2d 753, 758. 221 USPQ 473, 477 (Fed. Cir. 1984). The contested language of claim 1 is reproduced below:

> 1. A method for determining a physical property of a specimen on the basis of interferometric optical phase discrimination comprising,
>
> in sequence,
>
> directing analytical radiation upon said specimen,
>
> along a course such that there is developed an optical phase difference between radiation emanating from a first radiation-reflective surface of said specimen, second radiation reflective surface of said specimen cyclically varying at a predetermined time rate the length of the path of travel of said radiation emanating from a given one of the pair consisting of said radiation-reflective surface of said specimen, and said second radiation-reflective surface of said specimen with respect to the length of the path of travel of the radiation emanating from the other of said pair,***.

At trial, Bio-Rad presented testimony of Mr. Johnston, a patent attorney, on the subject of claim interpretation. The witness testified that to clearly require performance of one step after another in the order listed, he would add the words "and thereafter" or similar language between the listed steps. Certainly such language in claim 1 would remove any ambiguity. Because the claim could have been more clearly written to require a specific sequence, but was not, there is room for reasonable

people to interpret the claim as urged by Bio-Rad. We emphasize that our task is not to interpret the claims as though no trial had occurred. Both parties submitted testimony in support of their interpretation before the jury. Bio-Rad's interpretation prevailed and was not overturned by the trial judge. On appeal, we consider only whether reasonable jurors could have interpreted the claim in the manner presumed. *Envirotech Corp. v. Al George, Inc.*, 730 F.2d at 758, 221 USPQ at 477. We conclude that reasonable jurors could conclude the claims simply require light to travel from a source to a detector in a manner that develops an optical phase difference.

Nicolet's second theory for overturning the judgment of infringement is that the '515 patent requires determining a sample's thickness by measuring time directly from an interferogram. In contrast, the MX-ECO measures thickness of a sample by measuring the distance traveled by the reciprocating mirror between occurrences of constructive interference.

The jury presumably concluded that one of ordinary skill in the art would understand that the MX-ECO's mirror time of travel is functionally equivalent to the mirror distance traveled. The patent specification uses "time" to encompass alternative approaches for determining the distance traveled by the mirror between the occurrence of a sideburst and a reference point. When the patent claims speak of "measuring the elapsed time" they also refer to the measurement of the distance the mirror traveled from a reference point to the position where a sideburst occurs. For instance, Figure 3 of the '515 patent shows both distance of mirror travel as well as time. Both distance and time may be used to determine the distance traveled by the mirror. The jury could also reasonably have drawn the presumed conclusion from other evidence produced by Bio-Rad such as Nicolet's sales brochure which described a Michelson interferometer used in the MX-ECO and stated that the mirror velocity must be constant during the scan. The evidence pro-

duced by Bio-Rad shows that although time and distance are different, they are related in this technological setting. Because of the close relationship between time and distance in this case, we cannot conclude that the jury's finding of infringement must be reversed.

Nicolet's argument that the MX-ECO applies mathematical formulas known as fourier transforms to the data of an interferogram does avoid infringement. Steps or features added to a claimed invention do not necessarily avoid infringement. *Radio Steel Mfg. Co.* v. *MTD Products, Inc.*, 731 F.2d 840, 221 USPQ 657 (Fed. Cir. 1984).

II. Grounds For New Trial

A. Form of Verdict

Nicolet argues that a new trial is required because the form of verdict used in this case was improper. Nicolet contends that the general verdict form permitted the jury to decide questions of law. This court has already held that there is no error inherent in submitting questions of law to a jury so long as the jury is adequately instructed. *Railroad Dynamics, Inc.* v. *A. Stucki Co.*, 727, F.2d at 1514-15, 220 USPQ at 937-38. Nicolet's argument for a new trial therefore has no merit absent some harmful error in the instructions.

The instructions in this case were jointly submitted by the parties to the court. When the instructions were given to the jury, Nicolet raised no objection to any of them. Ordinarily, a party must object to an instruction in time to give the trial judge an opportunity to correct the alleged error before the jury returns its verdict. If no objection is raised, the instructions cannot be challenged on appeal unless great injustice would result. *See American Hoist & Derrick Co.* v. *Sowa & Sons, Inc.*, 725 F.2d 1350, 1364, 220 USPQ 763, 774 (Fed. Cir. 1984).

B. Instruction On Burden Of Proof

Nicolet also argues that the trial judge failed to properly instruct the jury on Nicolet's burden for proving invalidity. The jury was instructed that the patent must be presumed valid and that the burden of proving invalidity rests upon Nicolet. The trial judge also told the jury that "[t]he presumption of validity is rebuttable only by clear and convincing evidence." Nicolet contends that the jury should have been told that the presumption of validity may be weakened or destroyed when prior art more pretinent than that considered by the examiner is presented at trial. Because prior art presented at trial was more pertinent than art before the examiner, Nicolet says the jury should have been instructed that Nicolet only had to carry its burden of proof by a preponderance of the evidence.

Nicolet cannot possibly show that great injustice was caused by the challenged instruction since this court has repeatedly held that the party asserting invalidity must prove facts capable of overcoming the presumption by clear and convincing evidence. The introduction of prior art not considered by the PTO does not change the burden of proof or the requirement that evidence establish the presumption-defeating facts clearly and convincingly. *Connell* v. *Sears, Roebuck & Co.*, 772 F.2d at 1549, 220 USPQ at 199. Nicolet's challenge to the burden of proof instruction is therefore without merit.

C. Abuse Of Discovery

Here, Nicolet says that Bio-Rad abused the discovery process to such an extent that a new trial is required. The argument is not premised on failure to disclose documents but on the production of certain documents during the trial. The documents involved opinions from attorneys on validity questions.

Questions regarding abuse of the discovery process are within the trial judge's province and denial of a motion for new trial based on such abuse will be overturned only if the denial

of a new trial is shown to be an abuse of discretion. *Edgar* v. *Finley*, 312 F.2d 533 (8th Cir. 1963). The disputed evidence was discovered during trial and the documents were entered as evidence in the case. The record indicates Nicolet had an adequate opportunity to examine witnesses necessary to explain the significance of these documents and to present arguments regarding their importance on the validity issues. Under these circumstances, we cannot say that an abuse of discretion occurred when Nicolet's request for new trial was denied.

D. **Damages**

Finally, to obtain a new trial, Nicolet argues the damages award is excessive. In attacking the jury award of $3,078,000, Nicolet assumes that lost profits were awarded on 91 MX-ECO instruments sold by Nicolet and that a reasonable royalty of $18,000 per instrument was assessed on each sale of 19 other MX-ECO instruments. Bio-Rad does not challenge this presumed analysis of the jury's award, as it appears to follow Bio-Rad's arguments to the jury on the damages issue. Although we are not required to follow the analysis presumed by the parties, we do so in this case and affirm the jury award.

To obtain lost profits, a patent owner must prove that he would have made the sales but for the infringing activity. The patent owner need not prove causation as a certainty, evidence showing a reasonable probability that Bio-Rad would have made the infringing sales Nicolet made will suffice. *Gyromat Corp.* v. *Champion Spark Plug Co.*, No. 83-1081/1149, slip op. at 9 (Fed. Cir. May 22, 1984); *Lam, Inc.* v. *Johns-Manville Corp.*, 718 F.2d 1056, 1065, 219 USPQ 670, 675 (Fed. Cir. 1983). The jury was instructed that Bio-Rad is entitled to lost profits on sales Bio-Rad would have made but for Nicolet's infringement and that several factors should be considered, including:

> whether plaintiff had the existing or at least potential manufacturing and marketing capabilities to obtain

> the infringing sales, whether plaintiff's FTG-12C and defendant's MX-ECO compete with one another, whether plaintiff's and defendant's marketing efforts were aimed at the same geographical markets and categories of customers, and whether there were any particularly close substitutes for the FTG-12C and the MX-ECO.

The instruction on lost profits is not challenged on appeal. We conclude that sufficient evidence was proffered by Bio-Rad to establish a reasonable probability that in the absence of Nicolet's infringement, Bio-Rad would have sold an additional 91 thickness measuring instruments. For instance, Bio-Rad showed demand for the claimed invention by proving Nicolet's sales of infringing instruments and licenses for the production and use of instruments embodying the claimed invention by two other corporations. Bio-Rad is the only company licensed to sell instruments embodying the invention of the '515 patent, with one inconsequential exception. Texas Instruments was licensed to sell five instruments embodying the claimed invention after Texas Instruments had used them for one year. This fact alone does not preclude the award of lost profits by the jury. In addition, Bio-Rad's witnesses testified that Bio-Rad's facilities were adequate or could have been made adequate to meet the additional demand for the claimed invention.

Nicolet argues that Bio-Rad is not entitled to lost profits because Bio-Rad did not establish the absence of acceptable noninfringing substitutes, one of the factors required by *Panduit Corp.* v. *Stahlin Bros. Fibre Works, Inc.*, 575 F.2d 1152, 1156 (6th Cir. 1978), to justify an award of lost profits.*/ We con-

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*/ Although this court has accepted the *Panduit* standard as a permissible way to establish entitlement to lost profits, we have not made that standard the exclusive one for determining entitlement to lost profits. *Central Soya Co.* v. *Geo. A. Hormel & Co.*, 723 F.2d 1573, 1579, n. 5, 22 USPQ 490 (Fed. Cir. 1983); *Gyromat Corp.* v. *Champion Spark Plug Co.*, No. 83-1081, slip op. at 5 (Fed. Cir. May 22, 1984).

clude there is sufficient evidence of record for a reasonable jury to find the absence of acceptable substitutes. Bio-Rad's market survey expert testified that in surveying purchasers of the Nicolet device, 70-90% of the interviewees would have purchased Bio-Rad's FTG-12 devices had Nicolet not been present in the market. Bio-Rad also points to admissions by Nicolet that Bio-Rad was Nicolet's sole competitor. We are also satisfied that the jury could reasonably conclude from the evidence that there were no other devices which could be deemed acceptable substitutes, especially in view of the fact that Nicolet did not offer any evidence to the contrary. Indeed, it is Nicolet's burden on appeal to show that reasonable jurors could not have concluded that but for Nicolet's infringement, Bio-Rad would have sold 91 additional instruments. Nicolet has failed to carry that burden here.

Nicolet also contends that the amount of lost profits awarded is so large that the jury verdict must be overturned or a new trial ordered. The amount of lost profits awarded cannot be speculative but the amount need not be proven with unerring precision. See *Lam, Inc.* v. *Johns-Manville Corp.*, 718 F.2d at 1065, 219 USPQ at 675; *Livesay Window* v. *Livesay Industries, Inc.*, 251 F.2d 469, 472, 116 USPQ 167, 169 (5th Cir. 1958).

To support its contention, Nicolet describes the testimony of Bio-Rad's accounting expert as speculative and without any reasonable basis. Bio-Rad's expert relied on an incremental cost accounting method that resulted in a profit of about $39,650 for each domestic sales and $34,313 for each foreign sale. This calculation included all of Bio-Rad's costs, except for direct selling expenses, labor and materials. We cannot conclude that the size of the award for lost profits was too speculative simply because the jury was guided by an incremental cost accounting method.

Nicolet also argues that the reasonable royalty, presumed

to be part of the damages award, is too high. They point out that the industry royalty rate runs from three to ten percent of sales while the royalty awarded by the jury approaches one third of the selling price of the MX-ECO. Though established royalty rates are normally applicable, *Hanson* v. *Alpine Valley Ski Area, Inc.*, 718 F.2d 1075, 1078, 219 USPQ 679, 682 (Fed. Cir. 1983), they do not necessarily establish a ceiling for the royalty that may be assessed after an infringement trial. *Cf. Tektronix, Inc.* v. *United States*, 552 F.2d 343 at 347 n.5, 193 USPQ 385 at 390 n.5 (Ct. Cl. 1977), *cert. den.*, 439 U.S. 1048 (1978). Appellant has not met its burden of showing that use of a higher rate was inappropriate under the circumstances of this case.

E. **Antitrust Counterclaim**

Finally, Nicolet argues it is entitled to a new trial on its antitrust counterclaims because the jury's incorrect analysis of validity and infringement necessarily resulted in their rejection of Nicolet's antitrust claims. In veiw of our affirmance of the decisions on validity and infringement, Nicolet's argument is without merit.

III. Patent Misuse

Nicolet's answer to Bio-Rad's complaint alleged patent misuse because of bad faith threats of patent infringement suits. Nicolet's answer said: "Plaintiff is estopped from enforcing said patent No. 3,319,515 by reason of misuse thereof in the form of bad faith threats of patent infringement suits based thereon." This was the only misuse theory presented to the jury. After the jury verdict was returned, Nicolet argued two different misuse theories to the trial judge in a motion to deny enforcement of the '515 patent. The trial judge denied the motion without comment. On appeal, Nicolet relies on the same two misuse theories that were presented only to the trial judge after the jury rendered its verdict. Nicolet would have this court declare the patent in suit unenforceable.

First, Nicolet argues that Bio-Rad misused its patent in 1969-1970 when Digilab refused to sell unpatented interferometers to Texas Instruments unless Texas Instruments took a license under the '515 patent. Second, Nicolet contends that misuse occurred when Bio-Rad and DuPont agreed to jointly enforce the '515 patent against Nicolet and created a joint litigation fund for that purpose. We do not address the merits of these contentions because Nicolet has waived the right to raise these misuse issues.

Misuse is an affirmative defense that must be pleaded and proved. 35 USC §282 (1976); *Trio Process Corp.* v. *L. Goldstein's Sons, Inc.*, 461 F.2d 66, 74, 174, USPQ 129, 135 (3d Cir. 1972), *cert. denied*, 409 U.S. 997 (1972). Nicolet and Bio-Rad both asked for a jury trial on all the issues. No issues were reserved for trial to the court only. In fact, in its Joint Pretrial Statement, Nicolet said "Bifurcation or separate trials of any issues is neither desired nor feasible." Because the affirmative defenses argued on appeal were not pleaded in Nicolet's answer or presented to the jury, we hold these defenses were waived and we need not consider them further. *See id.* at 461 F.2d at 74, 174 USPQ at 135.

Nicolet relies on *In re Yarn Processing Patent Validity Litigation*, 472 F.Supp. 170, 205 USPQ 758 (S.D. Fla. 1979) (*Yarn Processing*) for the proposition that misuse *must* be decided by the court and not the jury. Nicolet's reliance on this case is unfounded. The plaintiff in *Yarn Processing* sued for infringement occurring after misuse had been purged and demanded a jury trial. The District Court granted a motion for separate trial to the court of the purged issues because they were separable from the infringement issues and their separate adjudication would expedite the litigation. The court concluded that trying the equitable misuse defense before a judge did not violate plaintiff's right to a jury trial. The decision in *Yarn*

Processing, therefore, has no bearing on this case where all issues were to be tried to the jury.

IV. Prejudgment Interest

The trial court denied Bio-Rad's request for prejudgment interest before the United States Supreme Court decision in *Devex Corp.* v. *General Motors Corp.*, 51 U.S.L.W. 4613 (May 24, 1983) was available. In that case, the Supreme Court said that prejudgment interest is compensatory, not punitive, and should be awarded under 35 U.S.C. § 284 absent some justification for withholding such award. Here the district court denied prejudgment interest but did not indicate that there was any reason for denying prejudgment interest. The determination of whether such a reason is present is for the trial court to ascertain in the first instance. We therefore *vacate* the trial court's denial of prejudgment interest and *remand* for an award of prejudgment interest or a determination that some specific justification exists for denying prejudgment interest. In all other respects, the judgment is *affirmed*.

AFFIRMED-IN-PART, VACATED-IN-PART, AND REMANDED

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL COURT

July 24, 1984

ERRATUM

Appeal Nos. 83-829/83-864

BIO-RAD LABORATORIES, INC., a Delaware Corporation v. NICOLET INSTRUMENT CORPORATION, a Wisconsin Corporation.

Decided: July 12, 1984

Please make the following correction:

Page 24, ultimate line – change "does avoid"
to –does not avoid–

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL COURT

BIO-RAD LABORATORIES, INC., a Delaware Corporation, *Appellee,*	)	
v.	)	No. 83-829 83-864
NICOLET INSTRUMENT CORP., a Wisconsin Corporation, *Appellant.*	)	

ORDER

A petition for rehearing and a suggestion for rehearing in banc having been filed in this case,

UPON CONSIDERATION THEREOF, it is Ordered by the court that the petition for rehearing be, and the same is hereby, Denied.

The suggestion for rehearing in banc is declined.

FOR THE COURT

/s/ George E. Hutchinson
George E. Hutchinson, Clerk

August 10, 1984
Date

cc: Harold C. Hohbach
Roger L. Cook

Office - Supreme Court, U.S.
FILED
NOV 5 1984
ALEXANDER L. STEVAS
CLERK

No. 84-562 (3)

IN THE

Supreme Court of the United States

OCTOBER TERM, 1984

NICOLET INSTRUMENT CORPORATION,
a Wisconsin corporation,
Petitioner,

v.

BIO-RAD LABORATORIES, INC.
a Delaware corporation,
Respondent.

Brief in Opposition to Petition for a Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

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November 1984

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No. 84-562

IN THE

Supreme Court of the United States

OCTOBER TERM, 1984

NICOLET INSTRUMENT CORPORATION,
a Wisconsin corporation,
Petitioner,

v.

BIO-RAD LABORATORIES, INC.
a Delaware corporation,
Respondent.

Brief in Opposition to Petition for a Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

RESPONDENT'S BRIEF IN OPPOSITION TO PETITION FOR WRIT OF CERTIORARI

Nothing about this patent case warrants review by this Court.

The decision of the Court of Appeals for the Federal Circuit awarding Respondent[1] damages for Petitioner's infringement of Respondent's patent is manifestly right. There is no conflict of decision. The petition raises no unsettled

[1] Pursuant to Rule 28.1, Respondent identifies International Plant Research Institute; Orimbio, S.A., Paris France; and O.E.M. Systems, Tokyo, Japan as affiliates.

questions of Federal law, no Constitutional issues, and no questions of public importance. There has been no departure from the accepted and usual course of judicial proceedings; indeed, Petitioner itself is responsible for the errors charged. In short, there is no special or important reason for granting a writ of certiorari in this case.

Petitioner, like many litigants, believes it should not have been found liable. Its contentions were carefully considered by a conscientious jury during 44 days of trial, by an experienced District Court, and by a competent Court of Appeals specializing in review of patent cases such as this. Yet, Petitioner asks this Court to review the issues of patent validity and infringement on a *de novo* basis. No such further review of Petitioner's contentions should be undertaken by this Court.

Questions Presented

Petitioner's four "Questions Presented" do not accurately state the issues which Petitioner would bring to this Court on certiorari. The questions actually presented by this petition are:

> (1) Whether it was reviewable error for the District Court to submit to the jury (a) certain questions on general verdict, without special interrogatories, where Petitioner itself insisted on that procedure over Respondent's objections; and (b) certain other questions where the Petitioner proposed that submission, consented to it, and never objected to it until after the verdict. This restates Petitioner's Questions Presented Nos. 1-3.
>
> (2) Whether it was reviewable error for the District Court not to have given a jury instruction requiring proof that the patentee's own product was covered by the patent, where Petitioner itself co-authored the instructions, never proposed contrary instructions, and never objected to the propriety of the instructions. This restates Petitioner's Question Presented No. 4.

STATEMENT OF THE CASE

The patent-in-suit, U.S. Patent No. 3,319,515, discloses a technique for high speed measurement of thin films. The patent illustrates the invention in terms of measuring clear cellophane film during manufacture, but nothing in the patent specification or claims limits the scope to any particular type of thin film (N App 8-13).[2] Claims 1-4 of the patent are directed to a method, while claims 5-7 are directed to equipment used to perform the method.

The instruments of both Respondent and Petitioner perform high speed measurements of the thickness of epitaxial ("epi") layers, which are thin films on semiconductor wafers (N App 28). Such measurement is desirable during the manufacture of integrated circuits for quality control purposes.

The invention's greatest success came in the semiconductor industry. Under exclusive license from the patent owner, E.I. DuPont de Nemours, Inc., Respondent and its predecessor, Digilab, sold some 185 epi gauges ("the FTG") (TR 794) at prices up to $65,000 per unit. Petitioner sold roughly half as many infringing gauges ("the MX-ECO") at lower, but comparable prices. At trial, Respondent introduced evidence to show that semiconductor manufacturers benefitted greatly from the invention: The FTG had the advantage of speed, ease of use and accuracy (TR 640). Texas Instruments manufactured its own in-house epi measurement system (TR 2350) pursuant to a license under the patent. Cox, of Texas Instruments, testified that the licensed in-house system increased measurement accuracy by a factor from 5 to 10, allowed one operator to handle what six or eight could before, and reduced training time from weeks to minutes (TR 2125-27). Petitioner's own expert, Dunn, testified that use of the machine saved one customer its $65,000 cost in two weeks (TR 2431).

The remainder of the facts in this case, particularly with regard to the structure and operation of the MX-ECO, the

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[2] In this brief, page numbers preceded by "N Br" and "N App" refer to Petitioner Nicolet's Brief and Appendix, respectively, and page numbers preceded by "BR App" and "TR" refer to Respondent BioRad's Appendix and to the trial transcript, respectively.

meaning of terms used in the patent claims *vis a vis* the MX-ECO and the prior art, the structure and operation of devices shown in the prior art, and the credibility of most expert and percipient witnesses were in sharp dispute and were the subject of conflicting evidence and/or inferences. Throughout its "Statement Of The Case" (N Br 3-6), and elsewhere, Petitioner makes extensive representations of fact that are actually Petitioner's contentions as to the above disputed issues, which contentions were rejected by the jury and both lower courts.

Both Respondent's patent infringement claim and Petitioner's antitrust counterclaim were tried to a jury. The jury rendered a unanimous verdict in Respondent's favor and against Petitioner on all counts. At no time prior to the verdict did Petitioner object to having any issue tried to the jury. Indeed, Petitioner itself successfully urged that patent validity including the question of "obviousness" be submitted to the jury, over Respondent's objection (TR 5907-5908, 5923).

Both the jury instructions and the form of verdict were jointly prepared and jointly submitted by the parties (TR 5906-5907). Respondent sought to have the form of verdict include specific questions for the jury to make factual findings regarding the factual elements of the *Graham* v. *Deere* test [383 U.S. 1, 15 L.Ed.2d 545 (1966)] so that the factual basis of the jury's obviousness determination could be assessed; however, Petitioner successfully opposed this form of verdict (TR 5902-04, 5907-08, 5910).

REASONS FOR DENYING THE WRIT

Petitioner's derogation of the jury system and this jury (N Br 7) is remarkable because, contrary to the premise upon which Petitioner's Questions Nos. 1-3 are based, Petitioner sought the result of which it now complains. Following closing argument, on December 21, 1982, trial counsel met with the District Court in chambers to discuss jury instructions and the form of verdict to be employed. Respondent's counsel argued that the question of patent validity should not be submitted to the jury, but that it should be reserved for the District Court

and that the subsidiary factual issues be submitted to the jury by special interrogatory. Petitioner opposed this procedure. Mr. Hohbach, Petitioner's trial counsel, summarized the dispute as follows:

> "Your Honor, let me ask you this question. One thing comes to mind with respect to validity and invalidity. I would think that Your Honor would want the jury to make the decision. They (Respondent) want, I guess, Your Honor to make the final decision after they answer these interrogatories." (TR 5923).

Petitioner succeeded in convincing the Court that patent validity should be submitted to the jury on general verdict, without special interrogatories, the very procedure which Petitioner now contends was in error.

Petitioner's slighting remarks about this jury are unwarranted. To assure the parties the opportunity to select the highest caliber jury, the District Court agreed to permit extra peremptory challenges, a privilege that Petitioner did not exercise. The jury of eight persons was conscientious (faithfully attending 44 days of trial), gainfully employed and well-educated (including an accountant, a college student, a nurse, a bacteriologist with college courses in physics, a systems analyst, and a postal department supervisor who had taken college courses in physics, chemistry and calculus). The jury's intelligent comprehension of the technical issues and its attentiveness to the proceeding were reflected in questions asked by the jury during trial.

1. Petitioner Itself Is Responsible For Each Alleged Error Upon Which The Questions Presented Are Based

Petitioner felt its interests were best served by a trial strategy and format in which all issues were submitted to the jury, on a general verdict without special interrogatories, with jury instructions it co-authored. Petitioner was successful in persuading the trial court to adopt this format, and must now accept the consequence of that success. On review, because the alleged errors were invited by Petitioner, they must be imputed to Petitioner, rather than to the lower courts. *St. Louis Public Schools* v. *Risley*, 77 U.S. 91, 19 L.Ed. 850, 857 (1869).

Petitioner is responsible for submitting patent validity (obviousness and anticipation) and infringement to the jury for determination. Not only did Petitioner convince the Court to submit validity to the jury, over Respondent's objection, but Petitioner co-authored and stipulated to the joint form of verdict which submitted both validity and infringement to the jury. Petitioner did not object to this submission at any time prior to the verdict, as contemplated by the F.R.Civ.P. Rule 39(a) (BR App 2b). This is dispositive of Petitioner's Questions Presented Nos. 1-3, discussed in greater detail below.

Petitioner is responsible for the court's use of a general verdict, having urged that general verdict be employed, over Respondent's objection, and having co-authored the form of verdict employed. This is dispositive of Petitioner's Questions Presented Nos. 1 and 3, discussed below.

Petitioner is responsible for the non-use of special interrogatories directed to subsidiary factual issues of patent validity, including the factual elements of obviousness pursuant to this Court's landmark decision, *Graham* v. *John Deere Co.*, 383 U.S. 1 (1966). Not only did Petitioner dissuade the District Court from using special interrogatories, as proposed by Respondent, but Petitioner never proposed its own special interrogatories or objected to their non-use prior to the verdict. This is dispositive of Petitioner's Question Presented No. 2.

Petitioner is responsible for the jury instructions employed, having co-authored and stipulated to those instructions, and having never objected to them (N App 44) "before the jury retire(d) to consider its verdict." F.R.Civ.P. 51 (BR App 3b). Under Rule 51, Petitioner's failure to object is fatal to its attempt to assign error to "the giving or failure to give an instruction". This is dispositive of all Questions Presented. Each of Petitioner's Questions Presented Nos. 1-3 turns on the propriety of the jury instructions. Moreover, the failure to seek jury instructions requiring proof that the patentee's product be covered by the patent is dispositive of Question Presented No. 4.

Appellate courts do not review matters as to which no objection has been raised below, absent great injustice not present here. *Hormel* v. *Helvering*, 312 U.S. 552, 556-557, 85

L.Ed. 1037, 1041 (1941); *General Utilities & Operating Co.* v. *Helvering,* 296 U.S. 200, 206, 80 L.Ed. 154, 157 (1935); *Springer* v. *United States,* 102 U.S. 586, 593, 26 L.Ed. 253, 256 (1880). Likewise, appellate courts do not review matters as to which the party seeking review itself has been the source of the error alleged. *Maxwell Land Grant Co.* v. *Dawson,* 151 U.S. 586, 605, 38 L.Ed 279, 285 (1894); *St. Louis Public Schools* v. *Risley,* 19 L.Ed at 857.

In addition, F.R.Civ.P. 39(c) (BR App 2b) provides that the jury's verdict on any issue submitted to the jury "*by consent*" has the "same effect"[3] as if it had been triable to the jury "as of right". Accordingly, on review, patent validity and infringement must be treated as though they were triable to the jury "as of right." Therefore, Petitioner is precluded from contending that validity and infringement should not have been submitted to the jury in the first place.

Finally, Petitioner is barred from contesting the substantiality of evidence in support of the verdict because Petitioner did not renew its motion for directed verdict at the close of all the evidence, as contemplated by F.R.Civ.P. 50(b) (BR App 3b). *Creative Cookware* v. *Northland Aluminum Products, Inc.* 678 F.2d 746, 748 (8th Cir. 1982); *Tights, Inc.* v. *Acme-McCrary Corp.,* 541 F.2d 1047, 1058 (4th Cir. 1976). This is dispositive of Question Presented No. 1, as will be discussed.

2. Validity And Other "Questions Of Law" Need Not Always Be Determined By The Court "As A Matter Of Law"

The jury did exactly what juries are supposed to do. It determined facts from the evidence presented; it learned the law from the trial judge; it applied the law to the facts; and it rendered a verdict. Petitioner's challenge of this process is based on a false premise. The fact that patent validity is a "question of law" does not mean that it should be determined differently from any other "question of law" which contains mixed questions of law and fact.

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[3] The "effect" of a jury's verdict, *vis a vis* the appellant's right to question it on appeal and the steps he must take to preserve that right are discussed at Moore's *Federal Practice,* Vol. 5, ¶38.08[5-7].

Patent validity, like other questions of law, is determined by the Court as a matter of law only (1) if there are no disputed subsidiary questions of fact, or (2) if the disputed subsidiary questions of fact are not supported by substantial evidence. Such is not the case here.

Where a general verdict is not accompanied by special interrogatories, reviewing courts presume that the jury made the factual findings and legal conclusions necessary to support the verdict. Assuming the verdict loser has preserved his right to do so, he may bring a motion for judgment notwithstanding the verdict, in which case it is his burden to show either (1) that the jury's presumed or express findings are not supported by substantial evidence, or (2) if the jury's findings were supported by substantial evidence, that the legal conclusions implied from the verdict cannot be supported by those findings. The verdict loser may also bring a motion for new trial, the grant or denial of which is reviewed on an abuse of discretion standard. Both the trial court and appellate court apply the same standards of review to a general verdict unsupported by special interrogatories.

The foregoing general principles are widely accepted as defining the traditional relationship of judge and jury with respect to determinations of law and fact, and have been applied in patent cases. *Panther Pumps & Equipment Co., Inc.* v. *Hydrocraft, Inc.*, 468 F.2d 225, 227-228 (7th Cir. 1972); *Tights, Inc.* v. *Acme-McCrary Corp.*, 541 F.2d at 1055-57. This is the procedural framework under which the present case was decided (N App 28-30), according to guidelines enunciated by the Federal Circuit[4] in *Railroad Dynamics, Inc.* v. *A. Stucki Co.*, 727 F.2d 1506 (Fed. Cir. 1984), *cert. denied* Oct. 2, 1984; *Perkin-Elmer Corp.* v. *Computervision Corp.*, 732 F.2d 888 (Fed. Cir. 1984), *cert. denied* Oct. 2, 1984.

Petitioner argues there are conflicts between the decisions of the Federal Circuit and five decisions of other circuits that Petitioner contends "require that the ultimate legal determina-

[4] This Court recently rejected opportunities to review the propriety of the foregoing procedures *vis a vis* determinations of patent validity on a general jury verdict without special interrogatories, in denial of petitions for certiorari on the Federal Circuit's leading cases on those topics (*Railroad Dynamics, cert. denied* Oct. 2, 1984 and *Perkin-Elmer, cert. denied* Oct. 2, 1984), where the same issues as Questions Presented Nos. 1-3 were raised.

tion of patent validity is to be made as a matter of law by the court and not by the finder of fact" (N Br 11). Having neglected to point out that it asked for the procedure of which it now complains, Petitioner further neglects to point out that Congress created the Federal Circuit with the *express* intention of resolving any conflicts among the decisions of the circuits[5] in the patent law; and that the five decisions relied upon by Petitioner no longer serve as precedent.[6] Thus any alleged conflict is strictly academic.

Petitioner argues that the "CAFC has created confusion within its own decisions as to the role of the court and jury in a patent case" (N Br 13), contrasting the present case with *Union*

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[5] Two years ago, Congress enacted the Federal Courts Improvement Act of 1982 (Pub.L.No. 97-164), and repealed 28 U.S.C. §1292(a)(4). As a result, appellate jurisdiction of judgments in civil actions for patent infringement is exclusively vested in the United States Court of Appeals for the Federal Circuit, 28 U.S.C. §§ 1292(c)(2); 1295(a)(1), for all cases in which notice of appeal was filed after October 1, 1982. By the time this legislation was enacted, numerous unresolved conflicts had arisen among the circuits on important points of patent law. "The Phoenix Court", Hon. Howard T. Markey, Ch. Judge, Ct. Fed. Cir., *Am.Pat.LawAssn.Q.J.*, Vol. 10, No. 4, pp. 227, 231-235 (1982). (BR App 4b). The legislative history of the Act states that Congress' purpose in establishing the new court was to resolve those conflicts:

> "Key provisions of the Federal Courts Improvements Act, and its intended results are as follows:
>
> **COURTS MERGERS**
>
> "First, it would combine the appellate judicial positions, jurisdiction of the Court of Claims with the positions, and jurisdiction of the Court of Customs and Patent Appeals, designating the *newly restructured court the U.S. Court of Appeals for the Federal Circuit.* This restructuring will resolve the gun-shy attitude many corporations, large and small, have with regard to investing the resources needed to develop and implement new technology; an attitude which is the result of the vague, unclear body of patent law which is developed through often *conflicting decisions* rendered by the various circuit courts of appeal....
>
> "The creation of the Court of Appeals for the Federal Circuit *will produce desirable uniformity* in this area of the law. *Such uniformity* will reduce the forum shopping that is common to patent litigation.... Moreover, *as the new court brings uniformity* to this field of law, the number of appeals resulting from attempts to obtain different rulings on disputed legal points can be expected to decrease." (emphasis added) [Cong.Rec.Sen., S.14693, Dec. 8, 1981.]

[6] As a result of this legislation, and because the new court has adopted as its precedent the decisions of the Court of Customs & Patent Appeals and the Court of Claims (*South Corp.* v. *United States,* 690 F.2d 1368, 1371 (Fed. Cir. 1982)) all of the circuit court decisions upon which Petitioner relies to show a conflict with the present decision have no further weight as precedent. *Roberts* v. *Sears, Roebuck & Co.,* 723 F.2d 1324, 1348 (7th Cir. 1983).

Carbide Corp. v. *American Can Co.*, 724 F.2d 1567, 1573 (Fed. Cir. 1984) which, Petitioner argues, "specifically held that the reviewing court is to review the issue of obviousness as 'one of law on which it must exercise independent judgment' (citation)" (N Br 13); however, *Union Carbide* involved appellate review of a documentary record on appeal from a grant of summary judgment. *Union Carbide* has nothing to do with "the role of the court and jury in a patent case" (N Br 13).

3. All Alleged Questions Of Law Were Correctly Decided And Reviewed In The Lower Courts

There was nothing inherently wrong in submitting any of the alleged "questions of law" to the jury for determination by general verdict. Each of those questions, anticipation,[7] obviousness[8] and infringement[9] involved disputed subsidiary questions

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[7] Disputed issues of fact regarding anticipation (i.e. did Loewenstein anticipate all claims of the patent-in-suit (N Br 10-11), included whether Loewenstein disclosed or taught measurement of thin films from the peaks of the interferogram (N App 36); whether substitution of a Michelson interferometer for the lamellar grating of Loewenstein would have been obvious to one of ordinary skill in the art when not working in the far infrared (N App 36); whether Loewenstein disclosed or suggested the mirror oscillation required by the claimed invention (N App 37). Expert testimony was heard on these issues, and the credibility of the experts was in issue by virtue of pertinent differences in their respective experience (N App 36-37).

[8] Determination of obviousness under 35 USC §103 is to be carried out in accordance with this Court's guidelines in *Graham* v. *John Deere Co.*, 383 U.S. at 17, 18, as follows:

> "While the ultimate question of patent validity is one of law, (citation omitted), the § 103 condition, which is but one of three conditions, each of which must be satisfied, lends itself to several basic factual inquiries. Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy. (citation omitted)".

Disputed issues of fact regarding obviousness included whether the Loewenstein article disclosed the mirror oscillation required by the claimed invention or whether it would have suggested that oscillation to one of ordinary skill in the art (N App 37); whether the Loewenstein article would have suggested use of a Michelson interferometer, as required by claim 6, to one of ordinary skill in the art (N App 37); whether persons of ordinary skill were skeptical of the invention (N App 37); whether the invention was a commercial success (N App 38); whether the invention reduced labor costs and increased productivity (N App 38); and whether $65,000 instruments

(footnote continued on following page)

of fact. Consequently, they were mixed questions of law and fact, properly determinable by a properly instructed jury. The propriety of the jury instructions is not in dispute (N App 44).

Petitioner argues that the language of the claims of the patent-in-suit was clear and unambiguous, and therefore that the scope of the claims should have been decided by the District Court and the Federal Circuit as a matter of law; however, Petitioner ignores the conflict in the evidence on the infringement question and in any event waived its right to raise this issue on appeal when it voluntarily submitted the question to the jury for determination.

Petitioner argues that the Federal Circuit's review of the verdict was improper because the only evidence it relied upon as "substantial evidence" in support of the verdict was expert testimony on the ultimate conclusion of validity (N Br 12-13); however, the Court's opinion makes it clear that, in reviewing the verdict, it looked at *facts*.

> "The only question for this court, therefore, is whether, on the *facts* testified to by Gebbie and presented by Bio-Rad, reasonable jurors could conclude that the invention would have been obvious to one of ordinary skill in the art at the time it was made." (N App 37).

In addition, because this argument is an attack on the substantiality of the evidence, Petitioner cannot be heard on it.

(footnotes continued from preceding page)

constructed in accordance with the invention caused savings so great that they could pay for themselves in about two weeks (N App 38). Here too, the credibility of witnesses was in issue (N App 36-37).

[9] Disputed issues of fact regarding infringement included whether the manner in which mirror travel is measured in the accused device is functionally equivalent to the manner called for by the literal language of the patent claims (N App 43); whether Petitioner's device avoided infringement by merely adding forward and then reverse Fourier transform steps to its operation (the "cepstrum" (N App 44)); whether the "in sequence" language of method claims 1-4 should be construed to mean "in a sequence" or, instead, "in the following sequence" (N App 42-43); and whether, if "in sequence" should be construed to mean "in the following sequence", was the sequence employed in Petitioner's device functionally equivalent (N App 42-43). Expert and lay witnesses testified on these subjects, and the credibility of their testimony was in question.

Petitioner did not renew its motion for directed verdict at the close of all the evidence and thereby forfeited its right to contest the substantiality of the evidence supporting the verdict. F.R.Civ.P. 50(b) (BR App 3b); *Creative Cookware* v. *Northland Aluminum Products, Inc.*, 678 F.2d at 748; *Tights, Inc.* v. *Acme-McCrary Corp.*, 541 F.2d at 1058.

Petitioner argues that the Court of Appeals must make an "independent evaluation" of the underlying facts on patentability (N App 11, 13), and that the Federal Circuit made no "independent review" of the record on validity (N Br 13). What Petitioner means by "independent review" and "independent evaluation" is unclear. If Petitioner means that either this Court or the Court of Appeals must sit as a jury and weigh the evidence, then the 44 days spent by the jury were wasted.[10] Plainly, where the credibility of witnesses is at issue, as it was in this case, the higher courts should not re-weigh the evidence as jurors, but should perform the traditional function of appellate courts on review, as the Federal Circuit did in this case (N App 29-30).

The Federal Circuit did not merely defer to the jury's decision. The verdict was brief and exceedingly general, whereas the Federal Circuit opinion is 24 pages in length, and contains 14 pages of detailed discussion on the technical facts (N App 31-44).

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[10] Not every determination of patent validity involves a constitutional question. Prior to 1952, the courts determined patentability under common law rules designed to satisfy the objective of the Constitution to promote the progress of science and the useful arts. Accordingly, the courts were applying and interpreting the Constitution directly. Thus, in *Great Atlantic & Pacific Tea Co.* v. *Supermarket Equipment Corp.*, 340 U.S. 147, 95 L.Ed. 162 (1950), Justices Black and Douglas declared, in dicta from a minority concurring opinion, that improper fact finding may not be a substitute for proper determination of patent validity. There, the lower courts had applied an improper standard. In 1952, following *A & P*, Congress enacted 35 USC §103 to satisfy the Constitutional standard. Subsequently, in *Graham*, this Court established guidelines for applying §103. Absent some question as to the standard of patentability, or as to interpretation of §103, neither of which is present here, the determination of validity in the ordinary patent case does not raise a Constitutional issue.

4. There Was No Abuse of Discretion In The Non-Use Of Special Interrogatories

Petitioner contends "a number of courts have insisted that the trial court employ special interrogatories setting forth the elements of the factual inquiry required in *Graham* v. *John Deere Co.*" (N Br 14); argues that the position of the Federal Circuit on the issue is "at best, confusing" (N Br 14); and says that the "supervision and guidance of this Court is needed" (N Br 15). However, Petitioner does not suggest what it is that this Court should do. Does Petitioner ask this Court to find it was an abuse of discretion for the Federal Circuit and District Court not to have required the special interrogatories that Petitioner itself successfully opposed? Does it offer special interrogatories that it contends should have been used? Or does it merely ask this Court to declare its position on special interrogatories for the benefit of future generations?

Plainly, this is not an appropriate case for this Court to consider on the topic of special interrogatories, a topic which this Court has previously declined to consider in *Railroad Dynamics, cert. denied* October 2, 1984.

Petitioner's authorities are no longer precedent and, even if they were, would not require a different result. In *Roberts* v. *Sears,* 723 F.2d at 1339, the Court found an abuse of discretion for non-use of special *verdicts* (F.R.Civ.P. 49(a)) (BR App 2b), not for non-use of special interrogatories (F.R.Civ.P. 49(b)) (BR App 3b), and its decision was based in part upon the fact that the appellant had objected to the jury being instructed to decide obviousness, and in part on the fact that the jury was plainly confused as to the manner in which that determination was to have been made. In *Baumstimler* v. *Rankin,* 677 F.2d 1061 (5th Cir. 1982), the Court merely expressed its preference (as dicta) for special interrogatories in patent cases, just as the Federal Circuit has expressed its preference.

Whatever "confusion" Petitioner experiences in interpreting the Federal Circuit's position on special interrogatories should be alleviated as a result of that Court's recently reported

decision in *Weinar* v. *Rollform, Inc.*, Nos. 84-515, 84-526, slip op. (Fed. Cir. Sept. 17, 1984) (BR App 7b), which flatly states that the Court's prior decisions did not and were never intended to mandate use of special interrogatories, and that the matter is left to the sound discretion of the trial courts.[11]

5. The Federal Circuit Did Not Err in Upholding The Award Of Damages For Lost Profits: Respondent Was Not Required To Prove Its Own Product Was Covered By The Patent Because The Jury Instructions Did Not So Require. There Is No Dispute Over The Propriety Of Those Instructions

Petitioner's contentions that the damage award is unsupportable because Respondent did not prove its own product was covered by the patent (N Br 20-21) ignores the fact that there was adequate evidence in the record from which a reasonable jury could have concluded that the Respondent's product, the "FTG" was covered by the patent. Specifically, Respondent took an exclusive license from the patent owner in 1970 and, thereafter paid the patent owner in excess of $300,000 in royalties on sales of the FTG; there was evidence that Petitioner's infringing product was a substantial copy of the FTG in all respects relevant to the patent; and one witness testified that the commercial success of the FTG was directly attributable to its embodiment of the invention of the patent.

Nevertheless, the stipulated jury instructions (N App 46-47) (BR App 10b, 11b) included no requirement that the patentee's product be covered by the patent, and the propriety of those instructions was not in issue before the Federal Circuit (N App 47). Thus the matter is not in issue before this Court.

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[11] The Federal Circuit conforms to the general rule that use of special interrogatories is discretionary with the trial court. F.R.Civ.P. 49(b) ("The court *may* require..."); Wright & Miller, *Federal Practice and Procedure*, Vol. 9 §2505, p. 492 (1971). Appellate courts have generally refused to find an abuse of discretion for non-use of Rule 49 devices. Wright & Miller, *supra*, Vol. 9, § 2505, p. 493; § 2511, p. 522 (1971):

> "The decision whether to use a general verdict unaccompanied by special interrogatories, as authorized by Rule 49(b), is similarly committed to the *unreviewable* discretion of the trial judge (citations omitted)". (Wright & Miller, *supra*, § 2511, p. 522) (emphasis added).

No decision of this court is to the contrary.

Even if the matter were properly in issue before this Court, there would be no reason for this Court to review the Question Presented. No decision of this Court suggests that a patentee must prove its own product to be covered by the patent to collect damages of any sort. Petitioner asserts that this Court's decision in *Westinghouse Electric & Mfg. Co.* v. *Wagner Electric & Mfg. Co.*, 225 U.S. 604, 56 L.Ed. 1222 (1912) "strongly implies" a contrary rule. However, *Westinghouse* was decided in an era when the *infringer's* profits were recoverable as a measure of damages, and dealt with whether the *infringer's* profit was attributable to the patent so as to justify the patentee's recovering the *infringer's* profits on a theory of unjust enrichment.

Moreover, the lower court cases Petitioner cites do not stand for the proposition asserted. The decision in *Panduit Corp.* v. *Stahlin Bros. Fibre Works, Inc.*, 575 F.2d 1152 (6th Cir. 1978) does not require that the patentee's product be patented,[12] and in any event is but one of the tests for recovery

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[12] Petitioner argues that the phrase "demand for the patented product" in *Panduit* means that the patentee's product must be patented; however, this was not an issue in *Panduit*, and when the subject phrase is placed in context, no such meaning appears:

> "To obtain as damages the profits on sales he would have made absent the infringement, *i.e.*, the sale made by the infringer, *a patent owner* must prove: (1) demand for *the* patented product, (2) absence of acceptable non-infringing substitutes, (3) *his* manufacturing and marketing capability to exploit the demand, and (4) the amount of profit *he* would have made." 575 F.2d at 1156 (emphasis added).

If the author of the test had intended the construction urged by Petitioner, presumably he would have said, instead, "demand for *his* patented product", since comparable pronouns were used in elements 3 and 4 of the test, where reference to the patentee was intended.

of damages in the form of lost profits.[13] The decision in *Velo-Bind, Inc.* v. *Minnesota Mining & Mfg. Co.*, 647 F.2d 965 (9th Cir.), *cert. denied* 454 U.S. 1093 (1981), turns on special facts not applicable here[14] and, in any event, is no longer precedent.

6. There Is No Conflict Of Decisions, And No Question Of Public Importance Is Presented

No suit has been brought against any other infringer of the patent in suit; no one else is infringing the patent; and no one else ever will infringe the patent, because it expired in May 1984.

Unlike cases relating to the patentability of micro-organisms and computer programs, this case presents no question of unusual public importance.

There is no conflict of decision as to the validity of this patent in the determinations of the jury, trial court and Court of Appeals; each upheld the patent as valid and infringed. There is no issue as to whether a proper standard of patentability has been employed.

In short, this is a commonplace private dispute. Applicable here are the rules stated in *Universal Oil Products Co.* v. *Globe Oil & Refining Co.*, 322 U.S. 471, 473, 88 L.Ed. 1399 (1944):

> "Where the questions presented by the contested claims of infringement and validity are purely factual, this Court ordinarily accepts the concurrent conclusion of the district court and Circuit Court of Appeals in these cases. (citation omitted)"

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[13] Other courts have awarded lost profits without a showing that the patent owner's device was covered by the patent. *Gyromat Corp.* v. *Champion Spark Plug Co.*, 735 F.2d 549 (Fed. Cir. 1984); *American Safety Table Co.* v. *Schreiber*, 415 F.2d 373 (2d Cir. 1969). A longstanding test, widely applied, requires only that a patent owner show a reasonable probability that it would have made the sale but for the infringing device. *Milgo Electronic Corp.* v. *United Business Communications, Inc.*, 623 F.2d 645 (10th Cir. 1980); *H.K. Porter Co., Inc.* v. *Goodyear Tire & Rubber Co.*, 536 F.2d 1115, 1122 (6th Cir. 1976); *Livesay Window Co.* v. *Livesay Industries, Inc.*, 251 F.2d 469, 471 (5th Cir. 1958). This test was sanctioned as an acceptable alternative to the *Panduit* test by the Court of Appeals for the Federal Circuit in *Lam, Inc.* v. *Johns-Manville Corp.*, 718 F.2d 1056, 1065 (Fed. Cir. 1983).

[14] *Velo-Bind* deals only with unpatented consumables arguably "tied" to a patented product, and the Court distinguished this from other situations where a tie-in did not exist.

and in *Keller* v. *Adams-Campbell Co.*, 264 U.S. 314, 319, 68 L.Ed. 705 (1924):

> "Such an ordinary patent case . . . this Court will not bring here by certiorari unless it be necessary to reconcile decisions of the Circuit Courts of Appeal on the same patent."

The record here does not present any substantial question of Federal law, or any Constitutional question requiring resolution by this Court. The unanimous decision by the jury, the District Court and the Federal Circuit are soundly based on the particular facts of this case and are in accord with the decisions of this Court.

Conclusion

This petition should be denied.

Respectfully submitted,

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November 1984

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Rule 39. Trial by Jury or by the Court

* * *

(a) By Jury. When trial by jury has been demanded as provided in Rule 38, the action shall be designated upon the docket as a jury action. The trial of all issues so demanded shall be by jury, unless (1) the parties or their attorneys of record, by written stipulation filed with the court or by an oral stipulation made in open court and entered in the record, consent to trial by the court sitting without a jury or (2) the court upon motion or of its own initiative finds that a right of trial by jury of some or all of those issues does not exist under the Constitution or statutes of the United States.

* * *

(c) Advisory Jury and Trial by Consent. In all actions not triable of right by a jury the court upon motion or of its own initiative may try any issue with an advisory jury or, except in actions against the United States when a statute of the United States provides for trial without a jury, the court, with the consent of both parties, may order a trial with a jury whose verdict has the same effect as if trial by jury had been a matter of right.

Rule 49. Special Verdicts and Interrogatories

(a) Special Verdicts. The court may require a jury to return only a special verdict in the form of a special written finding upon each issue of fact. In that event the court may submit to the jury written questions susceptible of categorical or other brief answer or may submit written forms of the several special findings which might properly be made under the pleadings and evidence; or it may use such other method of submitting the issues and requiring the written findings thereon as it deems most appropriate. The court shall give to the jury such explanation and instruction concerning the matter thus submitted as may be necessary to enable the jury to make its findings upon each issue.***

(b) General Verdict Accompanied by Answer to Interrogatories. The court may submit to the jury, together with appropriate forms for a general verdict, written interrogatories upon one or more issues of fact the decision of which is necessary to a verdict. The court shall give such explanation or instruction as may be necessary to enable the jury both to make answers to the interrogatories and to render a general verdict, and the court shall direct the jury both to make written answers and to render a general verdict.***

Rule 50. Motion for a Directed Verdict and for Judgment Notwithstanding the Verdict

* * *

(b) Motion for Judgment Notwithstanding the Verdict. Whenever a motion for a directed verdict made at the close of all the evidence is denied or for any reason is not granted, the court is deemed to have submitted the action to the jury subject to a later determination of the legal questions raised by the motion.***

Rule 51. Instructions to Jury: Objection

At the close of the evidence or at such earlier time during the trial as the court reasonably directs, any party may file written requests that the court instruct the jury on the law as set forth in the requests. The court shall inform counsel of its proposed action upon the requests prior to their arguments to the jury, but the court shall instruct the jury after the arguments are completed. No party may assign as error the giving or the failure to give an instruction unless he objects thereto before the jury retires to consider its verdict, stating distinctly the matter to which he objects and the grounds of his objection. Opportunity shall be given to make the objection out of the hearing of the jury.

THE PHOENIX COURT

BY CHIEF JUDGE HOWARD T. MARKEY

APLA Quarterly Journal, Vol. 10,
No. 4, p. 227 et seq. (1982)

* * *

V. Opportunity To Clarify The Law

One opportunity immediately presents itself. Because the court is interpreting and applying the law to patent applications and to issued patents, a chance exists to clear the air on both sides of the issue date.

Not only the opportunity, but the duty of clarifying the law of patents itself will require the resolution of numerous apparent conflicts lurking in past decisions and decisional approaches of various courts. What follows are a few examples.

Some courts appear to have adopted synergism as a condition of patentability and others have not. Where obviousness has been held a question of fact, a finding of obviousness or nonobviousness by the trial court can be viewed as insulated from appellate review unless "clearly erroneous" under Fed.R.Civ.P.52(a), and, in a jury trial, the jury resolves the issue. Where obviousness has been held a question of law, the trial judge may decide it and it can be viewed as fully reviewable on appeal.

Some courts appear to have held that a licensee may challenge the validity of the licensed patent in a declaratory judgment action without terminating the license. In another court it appears that such action will be dismissed for lack of a justiciable controversy.

A court appears to have held that the standard for review of obviousness of a design invention is the "ordinary intelligent man."[5] Others appear to have adopted the "ordinary designer" standard.

A presumption of obviousness of a claimed compound, based on structrual similarity to one in the prior art, appears to have been held rebuttable by evidence that the compound

possesses new and unexpected properties. Other courts have applied differing views.

To establish a "failure to disclose best mode" defense in some courts, it appears that both knowledge and intent to conceal must be shown.[8] In others, it appears that a patent may be invalidated if the inventor knew of a better mode, regardless of intent.

In one court it appears that unless a contract for sale contains an express or clearly implied condition that the sale is primarily for experimental purposes, there will be no inquiry into its experimental nature. In another, it appears that evidence of experimental intent may be considered when no such intent is indicated in the sale contract.

In one court it appears that a patent may be corrected by adding the name of a joint inventor though neither the named inventor nor the assignee agrees. In another, it appears that the patentee must cooperate to effect the change.

In one court it appears that there must be an amendment to a claim before the doctrine of file wrapper estoppel will be invoked. In another, it appears that an attorney's remarks can be sufficient to invoke the doctrine.

Is a patentee, who is estopped from enlarging the scope of amended claims to encompass an alleged infringer's product, also estopped from contending that his patent, as issued, is nonobvious? In one court, it appears that he is not. In another, it appears that he is.

In one court, it appears that *Muncie* prohibits introduction of claims after the bar period even though those claims are supported by the application as originally filed. In others, it appears that *Muncie* is merely a prohibition against new matter.

In some courts, it appears that the burden of proof to establish a public use or an on-sale bar is clear and convincing evidence. In another, it appears that the burden requires clear, convincing, and substantial evidence. And in another, it appears that the burden is one of "beyond a reasonable doubt."

One court appears to require that courts decide infringement first, and then decide validity only if necessary. Another appears to require that courts decide validity first, and then decide infringement only if necessary.

The foregoing list is certainly not exhaustive. It appears sufficient to illustrate, however, something of the task faced by the CAFC in bringing uniformity and reliability to the law of patents. (citations omitted)

United States Court of Appeals for the Federal Circuit

ROGER NEIL WEINAR, an individual, CONCEPT SEARCH, INC., a corporation, and NATIONAL GYPSUM COMPANY, a corporation,

Appellees,

v. **Appeal No. 84-515**

ROLLFORM INCORPORATED, a corporation,

Appellant.

ROGER NEIL WEINAR, an individual, CONCEPT SEARCH, INC., a corporation, and NATIONAL GYPSUM COMPANY a corporation,

Cross-Appellants,

v. **Appeal No. 84-526**

ROLLFORM INCORPORATED, a corporation, and GEORGE C. ADAMS, an individual,

Cross-Appellees.

DECIDED: September 17, 1984

Before MARKEY, *Chief Judge,* NICHOLS, *Senior Circuit Judge,* and KASHIWA, *Circuit Judge.*

MARKEY, *Chief Judge.*

* * *

APPEAL NO. 84-526

Interrogatories

Like Rollform, Weinar attempts much from the election of the trial judge to forego submission of fact interrogatories to the jury. Weinar's plaintive cry that there is "no record" to show which findings or legal grounds formed the basis for the jury's

verdict that the '095 and '580 patents are invalid, is of interest in view of its ready acceptance of the same jury's verdict that the '644 patent is valid. It is also wrong.

* * *

At trial, it was Rollform who requested the submission of interrogatories and it was Weinar who successfully objected to the submission. Indeed, the district court adopted the jury instructions proposed by Weinar. On at least two grounds, therefore, Weinar's argument is improper. First, if error had occurred, it would have been an "invited error" not subject to consideration on appeal. Second, Weinar's failure to object to the absence of interrogatories precludes the assignment of that absence as error here.

Recognizing its failure to request interrogatories, or to object to their absence, Weinar says its failure must be here disregarded because there has been an intervening change in the law and appellate courts must apply the law as it exists when the appeal is decided, absent manifest injustice. Weinar's difficulty is that the law has not changed.

Weinar's notion that the law on interrogatories was "changed" by this court in *American Hoist & Derrick Co.* v. *Sowa & Sons, Inc.*, 725 F.2d 1350, 220 USPQ 763 (Fed. Cir. 1984), is wrong. Weinar's statement that this court "reversed a holding of invalidity for obviousness" because interrogatories were not used is untrue. This court in that case remanded because of erroneous instructions on the law of fraud and obviousness.

It is true that the court in *American Hoist* said the district court "should have" submitted interrogatories, but in view of the language of Fed. R. Civ. P. 49 ("a court *may* submit" [emphasis added]) it would improperly invade the right of a district judge to manage trials if an appellate court were to reverse in reliance on its own view that the rule should say "*shall* submit". The role of an appellate court does not include modification of the Federal Rules of Procedure approved by the Supreme Court and mandated by the Congress, and this court in *American Hoist* attempted no such modification.

It is also true that in *American Hoist,* in *Railroad Dynamics, supra,* and in *Connell, supra,* this court noted an advantage accruing to judges on review of jury verdicts when those verdicts are accompanied by answers to fact inquiries. In *American Hoist,* this court noted earlier decisions of other circuits which, for some reason, saw that advantage as somehow more attractive in "a patent case". Given the same familiarity with the substantive law involved, however, the advantage to a reviewing judge is the same in any kind of case.

An appellate court should not vacate a judgment on a jury verdict solely because the trial judge declined to submit fact interrogatories to a jury. To do so would abrogate the discretion of the trial judge explicitly provided by Rule 49. To do so with respect to some but not other patent cases would confront the trial judge with a definitional quagmire.

Whatever advantage may accrue at the review stage, there are other stages in the judicial process, and submission of interrogatories is not in all cases an unmixed blessing. The decision to submit interrogatories, and the precise language in which they are couched, can have an untoward effect on a verdict, if certain elements of the trial or the evidence are thereby overly emphasized in the jury's mind. The potential for confusion and for conflict in answers to interrogatories and the verdict may be increased. The nature of the trial and the evidence, and the events at trial, may well influence the decision to employ or forego interrogatories.

The foregoing and other considerations reflect the wisdom of continuing to repose the question of submitting interrogatories within the sound discretion of the trial judge who is most familiar with all the courtroom circumstances existing at the time. With the knowledge of those circumstances fresh, and in expectation of a motion for JNOV and an appeal, trial judges can be trusted to employ interrogatories when it appears that the advantages of that step on review of the jury's verdict outweigh the potential for untoward results outlined above.

* * *

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UNITED STATES DISTRICT COURT

FOR THE NORTHERN DISTRICT OF CALIFORNIA

BIO-RAD LABORATORIES, INC.,
a Delaware corporation,
Plaintiff,

v.

CIVIL ACTION No.
C81-2553 SAW

NICOLET INSTRUMENT CORPORATION,
a Wisconsin corporation,
Defendant.

PATENT JURY INSTRUCTIONS

TOWNSEND and TOWNSEND

By /s/ J. GEORG SEKA
J. Georg Seka
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By /s/ HAROLD C. HOHBACH
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Jury Instruction No. 50

DAMAGES: LOST PROFITS

If you find that the Flournoy patent is valid and infringed by the MX-ECO, and that by reason of such infringement plaintiff Bio-Rad has lost sales of the FTG-12C instrument, plaintiff shall be entitled to recover an amount equal to its lost profits.

To award lost profits, you must find by a preponderance of the evidence that plaintiff Bio-Rad would have made some of the sales but for the activities of the defendant Nicolet. You should consider such factors as whether plaintiff had the existing or at least potential manufacturing and marketing capabilities to obtain the infringing sales, whether plaintiff's FTG-12C and defendant's MX-ECO compete with one another, whether plaintiff's and defendant's marketing efforts were aimed at the same geographical markets and categories of customers, and whether there were any particularly close substitutes for the FTG-12C and the MX-ECO.

If you find that plaintiff has established a reasonable estimate of the number of the FTG-12C it would have sold had it not been for the infringement, you must then determine the profit that plaintiff would have made on each of such instruments that it would have sold. This determination involves plaintiff's financial records only, and requires a demonstration by plaintiff of the differences between the costs and revenues, the plaintiff would have experienced in the absence of the infringement.

For those MX-ECO sales by defendant where you find that plaintiff would not have made the sale, even in the absence of the infringement, you may not award lost profits, but rather you must award an amount based on a reasonable royalty which I will soon explain.

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CLERK

No. 84-562 (4)

IN THE

Supreme Court of the United States

OCTOBER TERM, 1984

NICOLET INSTRUMENT CORPORATION,
a Wisconsin corporation,
Petitioner,

v.

BIO-RAD LABORATORIES, INC.
a Delaware corporation,
Respondent.

Reply to Brief in Opposition to Nicolet's Petition for a Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

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CONSTITUTION

Article I, Section 8 4

I. THE ISSUES RAISED BY NICOLET IN ITS PETITION FOR A WRIT OF CERTIORARI SHOULD BE REVIEWED BY THIS COURT ON THEIR MERITS.

In its Petition for a Writ of Certiorari, Nicolet has raised issues which focus on the constitutional nature of determinations concerning patent validity and infringement and the manner of submission of those issues to a jury to ensure that improper fact finding does not substitute for a proper determination of patentability. Nicolet has shown that the decision below of the Court of Appeals for the Federal Circuit ("CAFC") is in conflict with the decisions of other federal courts of appeals, is in conflict with other of the CAFC's own decisions, reaches important issues of federal law which should be settled by this Court, and that this Court's exercise of its supervisory authority is necessary to provide guidance to the trial courts and appellate courts in the area of patent jury trials. These essential issues, which have a profound effect on the nation's patent system given the increasing use of patent jury trials, should be resolved by this Court. It is all the more important that the Court resolve the issues raised given the early stages of the development of the CAFC and the lack of unity within the decisions of that court.

Bio-Rad has argued that this Court should ignore the issues raised by Nicolet because Nicolet did not object to the jury instructions.[1] Bio-Rad also argues that for this reason Nicolet may not now complain that the trial court allowed the jury to determine the ultimate legal issue of patent validity without itself undertaking a decision on that issue of law.

---

[1] Bio-Rad has chosen to ignore the circumstances under which the jury instructions arose. The trial court at the commencement of the trial indicated to counsel for both parties that it would be incumbent upon them to prepare the jury instructions because the trial court had no prior experience in a patent infringement jury case (TR 5903) (TR refers to trial transcript) and that it would be necessary for counsel to reach agreement between themselves. With this direction from the trial court, the task of preparing the jury instructions was divided with Bio-Rad pre-

Such an argument ignores the record in this case and the precedents of this Court which render the trial court's failure to undertake such a review plain error. Moreover, the issues are of constitutional dimensions and profoundly affect the public interest and should be resolved by this Court.

The record indicates that before the trial court entered judgment on the jury's verdict, Nicolet advised the court that applicable law required the court to itself determine the legal issue of validity and to itself determine the scope of the claims of the patent as a matter of law. Reference to the court's order for judgment makes it clear that the court made no independent determination of legal issues concerning patent validity or those related to infringment. (N.App. 19).[2] Whether or not it was proper for the trial court to allow the jury to render an advisory

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paring the patent instructions and Nicolet preparing the antitrust instructions. No agreement could be reached on the jury instructions throughout the trial and they were still in issue after the closing arguments had been made to the jury just before Christmas. (TR 5903-05). It was only as a last resort in order to obtain settled patent instructions as required by the trial court that Nicolet made concessions to Bio-Rad. (TR 5906).

The forms of verdict proposed by Nicolet and Bio-Rad were reviewed by the trial court (TR 5903). The so-called interrogatories of Bio-Rad were not addressed to factual issues in the case but rather were merely a paraphrase of the jury instructions and the law (TR 5918) and the trial court so found (TR 5902). At no time did Bio-Rad suggest submitting any interrogatories directed to *Graham* factual issues. However, again the trial court insisted that counsel resolve between themselves a suitable form of verdict (TR 5923) so he could instruct the jury with the settled instructions (TR 592-5969). A form of verdict was finally agreed upon and given to the jury at 4:00 p.m. on December 22, 1982. (TR 5975). This form of verdict was the result of prolonged negotiations in which counsel for Bio-Rad insisted that the jury answer certain questions if claims of the patent in suit were invalid but refused to include any similar questions if the patent claims were found to be valid. Since the jury found the patent valid, there is no basis for ascertaining how the jury made this decision. Thus it was at Bio-Rad's insistence that a general verdict on validity was rendered.

[2] In this brief, page numbers preceded by N. App. refer to Nicolet's Appendix filed with its Petition. N.P. refers to its Petition. Page numbers preceded by BR App refer to Bio-Rad's Appendix to its Brief in opposition to Nicolet's Petition. BR Br refers to Bio-Rad's Brief.

verdict on these ultimate legal issues, it clearly was improper for the court to refuse to perform an independent determination of these legal issues as required by the decisions of this Court and federal courts of appeals.[3] *See Sakraida v. Ag Pro, Inc.*, 425 U.S. 273, 280 (1976), *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966); *Roberts v. Sears, Roebuck & Co.*, 723 F.2d 1324, 1343 (7th Cir. 1983); *Baumstimler v. Rankin*, 677 F.2d 1061, 1070 (5th Cir. 1982).

Bio-Rad has attempted to frame the issue herein as one of Nicolet's failure to object to the jury instructions. It then argues that Rule 51 of the Federal Rules of Civil Procedure forbids Nicolet from assigning as error any objections it now has to those instructions. (*See* BR Br 6). This argument misses the point. With regard to the issues of patent validity and claim interpretation, the focus of Nicolet's concern is not on the instructions, but on the failure of the trial court to perform any independent determination of those issues after the jury rendered its verdict. Rule 51 does not speak to this situation. Moreover, the trial court's action constituted plain error in light of the precedents of this Court holding that determination of patent validity and the scope of claims is to be made as a matter of law. Even if the issue could be framed as one of failing to object to jury instructions, because of this plain error, no objection was necessary. *See Beardshall v. Minuteman Press International, Inc.*, 664 F.2d 23, 26 (3rd Cir. 1981); *Rodrique v. Dixilyn Corp.*, 620 F.2d 537, 540 n. 5 (5th Cir. 1980).

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[3] Bio-Rad has urged that no weight should be accorded any opinions of courts of appeals other than those of the CAFC because those opinions are not binding on the CAFC. (BR Br 9 n.6) The opinion of any court of appeals is not binding on any other court of appeals, but that does not mean no weight should be given to well reasoned decisions of other circuits addressing the same issues. Similarly, here the well reasoned opinions of various courts of appeals are entitled to weight even though they do not bind the CAFC. Judge Nichols of the CAFC has recognized this and in a concurring opinion commended *Roberts v. Sears Roebuck & Co., supra*, as a good dissertation on the determination of the issue of obviousness. *See Railroad Dynamics Inc. v. A. Stucki Co.*, 727 F.2d 1506, 1524 (Fed. Cir. 1984) (Nichols, J., concurring).

Bio-Rad asserts that, because Nicolet failed to make a motion for directed verdict at the close of all the evidence, even though it made one at the close of plaintiff's case, this Court is precluded from considering the issues that Nicolet raises. This argument must be rejected for two reasons. First, the issues sought to be reviewed by Nicolet are legal in scope and the sufficiency of the evidence is not at issue. Second, the trial court indicated that such motions were unnecessary and in any event would not be seriously considered given the length of the trial. Under these circumstances, should it become unnecessary to review the sufficiency of the evidence, Nicolet has not waived its right to such a review. *See Bonner v. Coughlin*, 657 F.2d 931, 938-39 (7th Cir. 1981); *Albrecht v. Herald Co.*, 452 F.2d 124, 127 (8th Cir. 1971).

The issues raised by Nicolet affect not only the parties to this litigation but also the public interest. The Constitution of the United States provides for the establishment of a patent system "to promote the Progress of, Science and useful Arts . . ." Art. I, Sec. 8. Because the patent system limits the technology available to the public through the grant of patent monopolies, the public interest is affected by any decision relating to the scope of patents. This Court's decision concerning the manner of submission of patent issues to juries will, of course, have a profound effect on the public interest served by and affected by the patent system.[4] In light of that interest, and the constitutional dimension of the issues raised by Nicolet, the procedural irregularities asserted by Bio-Rad, even if they did have merit, should not be allowed to foreclose this Court's review of the important issues raised by Nicolet's Petition for a Writ of Certiorari.

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[4] Indeed, in this case the trial court, in recognition of that public interest, suspended an injunction previously entered against Nicolet forbidding it from infringing the patent. It found Nicolet should be permitted to sell such instruments, pending appeal, since the public had exhibited a marked preference for Nicolet's product over Bio-Rad's product. (N. App. 23).

Although all the procedural matters now raised by Bio-Rad were raised before the CAFC below, that Court did not base its affirmance of the trial court on any of those grounds. Rather, the Court based its decisions on the substantive points raised by the parties. It is that decision which Nicolet asks this Court to review.

II. THE DETERMINATION OF PATENT VALIDITY AND INTERPRETATION OF PATENT CLAIMS SHOULD HAVE BEEN PERFORMED BY THE LOWER COURTS AS A MATTER OF LAW.

Bio-Rad argues that, as with any other jury trial, the jury in a patent case is to be allowed to determine the ultimate legal issues, including patent validity and interpretation of claims, after being instructed by the Court. This position clearly ignores the precedents of this Court which mandate that special care be taken by the judiciary to ensure that improper fact-finding does not substitute for a proper legal determination of patent validity. These decisions were motivated by the recognition that the patent standard is basically constitutional and that patents have the effect of granting a private monopoly.[5] *See Anderson's-Black Rock v. Pavement Salvage Co.*, 396 U.S. 57, 61 (1969). Applying this standard, this Court has on a number of occasions independently evaluated underlying facts to determine the legal issue of patentability. *See, e.g., Sakraida v. Ag-Pro, Inc., supra.* at 280; *Anderson's-Black Rock, Inc. v. Pavement Salvage Co., supra.* at 62-63. Although these decisions involved fact-finding by a judge rather than the

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[5] Bio-Rad has stated that determination of validity in an ordinary patent case does not involve a constitutional question. (BR Br 12 n.10). This Court has, however, noted that the standard of patentability is basically constitutional. Although 35 U.S.C. § 103 specifically defines the standard of patentability with regard to obviousness, the fact remains that the constitutional standard may not be ignored. *Anderson's-Black Rock, Inc. v. Pavement Salvage Co., supra.* at 61-62.

jury, there is no reason to believe that this standard would not apply where the jury is the trier of fact. *See Roberts v. Sears, Roebuck & Co., supra.*

In its brief, Bio-Rad feigns ignorance as to what independent evaluation of the underlying facts would entail. (BR Br 12). One need look no further than this Court's own decisions to find that such independent review was performed by this Court and to see the manner in which that review was performed. *See Sakraida v. Ag-Pro., Inc., supra.; Anderson's-Black Rock, Inc. v. Pavement Salvage Co., supra.; Graham v. John Deere Co., supra.* Such an independent review would not, contrary to Bio-Rad's assertions, render the trial days spent a waste of time. Rather, it would assure that constitutional standards for patentability have been met. Of course, given the failure to submit special interrogatories to the jury to determine the underlying fact-finding, the trial court's responsibilities in this regard would have been more difficult. The trial court did not, however, even attempt to perform such a review.

Bio-Rad has argued that there were a number of disputed issues of fact relating to anticipation, obviousness, and infringement which rendered the issues in the case "mixed questions of law and fact, properly determinable by a properly instructed jury." (BR Br 11). There simply is no support for such a proposition in the decisions of this Court. In the landmark decision of *Graham v. John Deere, supra* at 17, the Court made it clear that underlying factual matters may be determined by the trier of fact, but the ultimate determination of validity is to be made as one of law. Bio-Rad's suggestion that because certain underlying facts are in dispute the legal question may also be decided by the trier of fact is directly contrary to the Court's pronouncement in *Graham.*

Bio-Rad has argued that the CAFC has consistently allowed the jury to determine the ultimate legal issue of validity without any independent determination of that issue by the judiciary. It thus argues that there is no conflict among the decisions of the

CAFC, and this Court should not grant certiorari to decide the issue of whether the trial court must make the ultimate determination of patentability in a case tried to the jury (BR Br 10). This argument must fail. The court in *Union Carbide Corp. v. American Can Corp.*, 742 F.2d 1567 (Fed. Cir. 1984) held that obviousness is to be determined by a reviewing court as an issue of law on which it must exercise independent judgment. Contrary to Bio-Rad's assertion, this holding is as applicable to a jury trial as to a motion for summary judgment. Whether the underlying facts are undisputed, as in *Union Carbide Corp.* or whether the underlying facts are found by a jury, the point is that the CAFC recognized that it was to review the question of obviousness as one of law, utilizing its independent judgment. This recognition creates a conflict within the decisions of the CAFC. In the present case the court performed no independent evaluation of the underlying evidence, but instead approached the problem as whether a reasonable jury possibly could make the ultimate legal conclusion it did (N. App. 37).

Moreover, if Bio-Rad is right that the CAFC has consistently ignored this Court's requirement that the courts independently review the legal issue of validity, the CAFC's decision represents a determination of an important federal question. This Court should exercise its supervisory authority to ensure that the proper legal standard is applied. *See generally* Rule 17, Rules of the Supreme Court of the United States.

Bio-Rad has also argued that the courts below were not required to construe the claims of the patent as a matter of law, but properly delegated this task to the jury because certain witnesses offered differing interpretations of the claim language. (BR Br 11). This misapprehends the well-established law that claim construction is a question of law for the judge where the language of the claims is clear. *See Coupe v. Royer*, 155 U.S. 565, 574-5 (1895); *Keystone Bridge, Co. v. Phoenix Iron Co.*, 95 U.S. 274 (1877). Bio-Rad's witnesses' opinions with regard to the language of Claim 1 of the patent requiring that certain

steps be performed "in sequence" were not sufficient to forbid the trial court from deciding the meaning of that term as a matter of law. The term "in sequence" is unambiguous, explicit and no interpretation is necessary. Under those circumstances the issue was to be decided by the trial court. The court refused to do so, even though Nicolet brought to its attention the need to do so before judgment was entered. It is essential that this Court provide guidance by requiring that unambigous claims be construed by the court and interpretation not be delegated to the jury.

III. THE USE OF SPECIAL INTERROGATORIES IN PATENT JURY CASES IS A MATTER THAT SHOULD BE ADDRESSED BY THIS COURT.

There can be little question that there was a lack of uniformity of decision among the various courts of appeals as to whether the trial court must employ special interrogatories setting forth the elements of the factual inquiry required in *Graham v. John Deere Co., supra.* As is more fully noted in Nicolet's Petition for a Writ of Certiorari (N P 14-15), precedents of the CAFC are now at best confusing. Bio-Rad suggests that the decision of a three-judge panel in *Weiner v. Rollform, Inc.*, (BR App 7b) ends the confusion. Instead, that decision adds to it. In *American Hoist & Derrick Co. v. Sowa & Sons, Inc.*, 725 F.2d 1350, 1361 (Fed. Cir. 1984) the CAFC favorably quoted a decision of the Fifth Circuit noting that the failure to use special interrogatories setting forth the *Graham* inquiries would "place a heavy burden of convincing the reviewing court that the trial judge did not abuse his discretion." By contrast, in *Weiner,* a different panel of the CAFC took an entirely different approach. (BR App 8b). Without the guidance of this Court, any district court faced with the trial of a patent jury case is provided with conflicting views of the matter which will provide it with no guidance. Given the considerable judicial resources expended in the trial of a patent-jury case, the trial courts are entitled to some guidance on this issue.

Bio-Rad has suggested that Nicolet has not been explicit in suggesting what this Court should do to provide guidance as to the issue of special interrogatories. Nicolet's position is simple. Where a case involves an issue of obviousness necessitating the three-part factual inquiry required by *Graham*, it is an abuse of the trial court's discretion to fail to utilize special interrogatories to ensure that the three-part factual inquiry was made. Without the benefit of such interrogatories the trial court will have no basis for its independent legal determination on the issue of obviousness. If the requirement of *Graham v. John Deere Co.*, is to mean anything, and legal determinations of patentability are to be intelligently made, nothing less is required.

IV. A PATENTEE IS NOT ENTITLED TO AN AWARD OF LOST PROFITS WHERE ITS PRODUCT IS NOT COVERED BY THE PATENT IN SUIT.

Bio-Rad has argued that because Nicolet stipulated to Bio-Rad's patent jury instructions on lost profits, there was no need for Bio-Rad to prove that its product, the FTG-12, was covered by the patent in suit. To the extent the instruction given on lost profits allowed submission to the jury of this issue without such proof, it represents fundamental and highly prejudicial error, requiring a new trial even in the absence of an objection. *See Morris v, Getscher*, 708 F.2d 1306, 1309 (8th Cir. 1983); *Rodrique v. Dixilyn Corp., supra.*

Bio-Rad further argues that coverage of the plaintiff's product by the patent is not an essential element of proof of lost profits. This is simply untrue. *Standard Mailing Machines Co. v. Postage Meter Co.*, 31 F. 459 (D.C. Mass. 1929). None of the cases cited by Bio-Rad in support of its position hold that there is no need to prove that plaintiff's product was covered by the patent. Rather, that issue was simply not raised in those cases.

Bio-Rad also argues that the *Panduit* test does not require the plaintiff's product to be covered by the patent because it

uses the phase "demand for *the* patented product" rather than "demand for *his* patented product" (emphasis added). (BR Br 15). To the extent there was an ambiguity in that case, the ambiguity was resolved by the court in *Milgo Electronic Corp. v. United Business Communications, Inc.*, 623 F.2d 645, 663 (10th Cir. 1980), relied upon by Bio-Rad in its Brief. There, in restating the *Panduit* test, the court used the phrase "demand for *his* patented product" (emphasis added). This is the phrase Bio-Rad has argued would demand proof that the plaintiff's product is covered by the patent. Indeed, any other formulation of the test makes little sense given that the purpose of an award of lost profits is to make the plaintiff whole. An award based on its inability to sell a product not covered by the patent bears no relationship to this purpose. It is essential that this Court resolve and clarify this issue particularly in view of the fact that the jury in this case awarded as lost profits approximately two thirds of the selling price of the instrument.

V. CONCLUSION

For the reasons stated in Nicolet's Petition for a Writ of Certiorari, the Writ should be granted. Bio-Rad's assertions to the contrary are without merit and only serve to emphasize the importance of resolving the fundamental issues raised by Nicolet.

Respectfully submitted,

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